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February

Main Freight Court in New Brooklyn Army Base

Freight in cars on tracks in the court, here shown only partly completed, will be unloaded by traveling plate-girder cranes to trailers standing on the balconies and thence moved to storage in the building. This is only one unit in the huge Army port terminal now being completed at Brooklyn and described in this issue. Over 135 acres of storage is provided in warehouses and on four connecting piers extending into deep water. This largest Army base has a peace-time value, both as an operating terminal and as an example for other work.

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A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

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An American Mayor

OLE HANSON of Seattle is a mayor to be proud of. Promptly and unanswerably he served notice last week that the legally elected representatives of the voters of Seattle would continue to run the city and that the first strike leader or other person who tried to usurp authority would be shot on the instant. Mayor Hanson's swift, manly action sets an example which may save other cities also from whimsical and tyrannous overnight attempts at minority government.

Irrigation Water Losses Increase with Temperature

THAT loss of water by seepage from irrigation canals may vary with temperature as much as 30% in a single season is the conclusion stated on p. 323 by an engineer who has been studying for many years the duty of water in irrigation. The studies on which this conclusion is based are part of a series carried on for an irrigation company during the past few years. The company deserves commendation for these investigations, as also do both it and the author of the paper for making them public.

Finish the Government Housing Developments

STOPPING a running machine dead is not good for the machine or its operator. It should be allowed to slow down. This seems to be the case with the Government housing program, as very cogently pointed out by Mr. Knowles on another page. Housing as an engineering problem is so new that the full benefit of the forced Governmental experiment is necessary to develop future possibilities. Half-finished projects will serve no useful purposes either to house workmen or to provide examples of practice. Let the Government complete all of the now necessary developments it has started, and leave the question of Government housing as a social panacea for future settlement.

Public Service Through United Engineering Action

TRUE public service was done by the engineers and engineering organizations that made the battle against the arbitrary action of New York City authorities in dismissing hundreds of engineers engaged in rapid-transit construction, a month ago. Now that the battle is won and the engineers have been reinstated, it is even clearer than before that the issue was of primary importance to the entire community and that those who championed the cause of the unjustly discharged men stood as the defenders of the public's interests. Though sympathy was engaged primarily by the immediate victims of official arbitrariness, the underlying spur to action was the certainty that necessary work would be paralyzed, to the community's great loss. By entering an energetic protest, the engineering profession took a step that is likely to be long remembered as a precedent. The success of this protest is an encouragement to further united action. No case could show more clearly than this one that in defending his own interests the engineer also serves the interest of the public. And if the professional interest can be upheld only through union, such union is not merely a privilege, an opportunity, but also a duty which every engineer owes to his fellow citizens.

Pass Some Kind of Water-Power Bill

NINETEEN days are left in which a Federal water-power bill can be enacted by the present Congress. If Mar. 4 goes by with the conference deadlock intact, years may pass before another Congress can bring a bill to the advanced stage the present Senate and House bills have now reached. Argument pro and con in the public prints can no longer avail much. Everything that is to be said has been said, except that it would be a crying shame to let petty differences now interfere to prevent the passage of some sort of act which will permit the necessary development of the water-powers of the United States.

An Engineer To Direct Construction

NEW lines of development of rapid-transit construction and planning in New York will come into prospect if the proposed appointment of Col. William Barclay Parsons to head the work is made a reality. There is so obvious a gain in handling a large construction enterprise through a competent and responsible directing head that many of the troubles which have attended the Public Service Commission's course would disappear. When five nontechnical men are set to carry out executive functions requiring knowledge of engineering and construction, difficulties are bound to develop. Of these, lack of coördination of thought is perhaps the most serious, and in New York transit matters very tangible evils have resulted herefrom. Governor Smith's offer to Colonel Parsons is reassuring evidence of progress in administrative methods—all the more so because it would separate the direction of construction work from rate regulation and other phases of state utility control.

Engineering Societies Show Greater Activity

THAT the organized activities of engineers are at last responding to the persistent exhortations of the past few years, that greater part should be taken in civic and social activities, is evidenced by the record found on the news pages of our last week's issue. Notice of a meeting of the New York members of the American Society of Civil Engineers, which developed an unusual discussion on the railroad situation and proposed principles of legislation; a suggestion by Michigan engineers for a state board of public works; a proposition by Indiana engineers for a joint license law with the architects, and insistence by Illinois engineers upon many kinds of state legislation—all are tangible demonstration that the profession is fast learning the art of progress through service. The time for talk and theorizing is past, the time for action has arrived. So many signs pointing toward right development are encouraging.

One Structure Where Operation Is Important

AS AN engineering performance, the Brooklyn Army Base is stupendous. Words and such illustrations as can be presented in these pages can suggest only faintly the hugeness of the operations that have been under way there for the past ten months. In its concentration of expenditure in comparatively small area it surpasses all of the many war jobs which have killed all hopes of record-breaking structures for many years to come. Everyone connected with the design and the construction helped mightily toward the winning of the war, though the base itself never got into operation. But in contrast to many war structures—or in fact, to most of the structures that civil engineers build—the most important interest in the base will be its operation. Together with the companion terminal at Boston, the Brooklyn project is expected to have a peace-time use as a freight-handling unit. It is, however, far larger and more elaborate than any similar terminal ever built, and this very elaboration complicates the design. The only excuse for a huge unit port terminal is the expected saving due to an orderly and rapid movement of freight plus the flexibility in operation and storage brought about by the immense warehouse area. On the economy of such projects as this, then, depend in great measure the future development in port designs and—not so far removed—the future of our merchant marine.

Motor-Driven Tractors Prepare Land for Irrigation

MOTOR-DRIVEN machinery was used in preparing a large tract of California land for irrigation, as described on p. 337. This practice will increase, since it is now seen that neither public nor private agencies do their part by merely selling so much rough land and so much water to the settler, but that they should level and perhaps otherwise prepare the land for the first crop and deliver water to the farmers' ditches. The apparent but not the real first cost of the farms will be increased by this practice. In the long run, both capital and operating charges will be reduced, and many a farmer saved from disappointment and disaster if his land is ready for cultivation when he takes possession of it. Besides the economy of large-scale operations under engineering direction, and the possibility of getting crops from all the land the first year, the farmer knows at the start just what the ready-to-use land will cost him, instead of facing the many risks due to uncertainties.

Motor-Truck Routes as Substitutes for Railway Branch Lines

FOR many years some British railways have preferred to run vehicles over highways into regions where comparatively little business originates, rather than to construct and operate branch railways. It has been known for some time that the engineering section of the United States Railroad Administration has been considering this subject. At the Jan. 16 meeting of the New York Railroad Club Charles A. Morse, in charge of engineering and maintenance in the Railroad Administration's organization, indicated his belief that under some conditions motor trucking would answer all the purposes of a branch line and save the railroad company the almost invariable loss which the operation of a branch entails. This is not a new thought from a railroad official. The late W. W. Finley was an ardent advocate of the improvement of roads leading out from railroad stations, and some of the most able arguments ever made for such betterments were presented by him with this principle of economic transportation as the basic reason for such public work.

It is pointed out by Mr. Morse that a branch railroad can often be built at a lower cost than a highway suitable for motor traffic, but this branch can only be used by rolling stock. The highway must be built, anyway. The economic problem is to determine whether it is wise to put enough money into the highway to make it fit for motor trucking, or whether it is better to leave the road fit only for light vehicular travel and put money into a branch railroad for the heavy freighting. Mr. Morse acknowledges that there may be branches which should be abandoned and their roadbeds turned into highways. He points out that long hauls by motor trucks may save transfer charges and other expenses which make branch lines unprofitable to the company and the shipper alike. In short, he takes the position that the subject to study is transportation as a whole, and not the relative merits of trucking and railway haulage as unrelated, conflicting rivals.

It is refreshing to have these comments from an eminent railway engineer. It is gratifying to have another dispassionate appeal for a comprehensive study of the economics of transportation from the viewpoint of the shipper and taxpayer and security holder. The engineering features of both railroad and highway construction are very simple, even elementary, compared with the economic problems which are presented by any real investigation of the choice of mode of transportation to be improved. These economic problems are little appreciated and still less studied. Moreover, in the present state of knowledge, essential data are to a large extent lacking in regard to highways. Nobody has been commercially interested in intensive and intelligent

studies of the transportation facilities which will best serve the welfare of the great mass of the people. But until such studies are made, and we really know as much about transportation as a whole as we now know about that limited part of transportation between the receiving and delivery doors of railroad freight houses, we are doing a good deal of guessing about what is the best thing to do. Some of our guesses will be incorrect and cause a waste of money.

Keeping Up the Shipbuilding Spirit of Shipyard Workers

WHEN we read of shipyard strikes here and there in the country, strikes of which that at Seattle is only a pronounced example, we link the news with other items on labor unrest, and think no more of causes. The phenomena of readjustment are hard facts. One man may call them inevitable, and another may charge them to unwise leadership, but they are with us, whether in textile mill or in copper mine or in shipyard.

But conditions in the shipyards are fundamentally different from those in other productive industries. Shipbuilding is not glutted with stocks like the copper field, or confronted by an uncertain market like the textile field. Its hours and wages are controlled by the Macy board. There are not the same causes for dispute as at Lawrence and Lowell. If conditions, then, are in every respect favorable to stability, to efficient production, the Emergency Fleet Corporation has at its command an engine of production that should function without friction. Yet there are strikes and disputes.

Four months ago we needed ships urgently. We need them just as urgently today. Four months ago every shipbuilding agency was driving forward at full speed; but today, though the drive is still on, it has not the same intensity of spirit.

Serious concern has been aroused in some shipbuilding districts by orders received from the Emergency Fleet Corporation to cancel plans for starting work on ships that would be completed late in the year. Among managers as well as among workmen, apprehension grew that shipbuilding would soon be brought to a stop. If the results are a safe criterion, these apprehensions played a part in stimulating unrest, in reducing efficiency, and in building up a strike sentiment.

The unfortunate part of the matter is that no curtailment of the shipbuilding program is involved either in this order or in prior orders issued by the corporation since October, and that nevertheless rumors of curtailment have been allowed to exert their harmful, disturbing influence.

Revision of the shipbuilding program with respect to types and sizes of vessels is now in progress. This important work will be of maximum value if its results can be applied as soon as possible, and are least hampered by the presence of keels on the ways and material in process. While this very good reason for the Fleet Corporation's order existed, yet an announcement in arbitrary form was allowed to disturb the working spirit of the yards. Together with earlier orders and announcements of the Shipping Board and the Fleet Corporation, it added measurably to the causes of industrial unrest.

An uncomfortable addition to the psychology of the moment has thus been made quite unnecessarily. Most urgent reasons exist, in the need for prompt steadying and resumption, for the exercise of tactful care in announcements and orders relating to labor matters and discontinuances. In the past the Fleet Corporation has often had to act summarily and sometimes in arbitrary manner. Now, however, the war period is over, and whatever causes may have justified arbitrary action and secrecy on the part of the corporation in that period have disappeared. The present times call for changed methods.

A Commission to Study the Colorado and Save Imperial Valley

JUST before the Colorado was turned back into its channel in 1906 a retreating waterfall marked the head of a new low-level channel which was moving up stream at the rate of one-fourth mile a day. With the repair of the break, the destructive waterfall was dried up, but there was left the long, deep channel through which the water had cut a way to Salton Sea. Should flood waters once again pour into that channel until its head cuts back across the present river bed, the fertile lands of the valley would become the bed of a great inland sea. There would be no hope of turning the river out of a channel cut below sea level. Last year's flood saw water lapping at the crest of Volcano Lake levee with nothing but low land beyond, and that sloping toward the dangerous channel cut in 1906. It is well known that the bed of the Colorado silts up rapidly, and no one can say how soon the flood menace may again become a reality in this as well as in other ways.

Too much emphasis, therefore, cannot be placed on the urgent and immediate need of protective measures. The half-million acres of irrigated lands in Imperial Valley alone produce annually crops valued at $25,000,000. It is absurd to jeopardize such valuable lands when permanent safeguards can be certainly and economically provided. Because of the present-day importance of productivity, such as that for which Imperial Valley is noted, it is more than ever necessary that the needed protection be provided speedily. Governor Cantu, of Lower California, has indicated his willingness to consider plans for improving the present situation, and the recent Imperial Irrigation District, election, on Jan. 21, although of no legal binding effect, was almost three to one in favor of the proposed contract with the Secretary of the Interior for an All-American canal, and nearly six to one for control by the United States Reclamation Service and for reservoir regulation of the Colorado.

In these conditions, the present is a most opportune time to take up in earnest the control measures so long deferred. Surely, there is common ground on which the various interests involved can get together and forget the petty quarrels that have made enemies of adjacent districts. Uncontrolled, the river is a constant menace to all, but with proper regulation it could be made a safe source for additional water which would

make possible a greater irrigated area for all the districts involved.

By way of constructive suggestion, the following is proposed as a means of securing the measures necessary: Let there be formed a Colorado River Commission consisting of three members, one representing the Reclamation Service and one representing the United States Army Engineers, and let these two select a third to represent independent irrigation interests. Such a commission, taking into consideration the rights of all irrigable areas involved with respect to the maximum use of all the water that can economically be made available, should be able to agree upon the necessary protective measures, more particularly the number and location of storage reservoirs on the head waters of the Colorado. It should also estimate their approximate cost and apportion the shares of such costs. This last might be done in the expectation that half the money would be apportioned by Congress from Federal funds, contingent upon the raising of the remainder from state and local sources. Precedent for the general features of this plan is found in the somewhat similar plan applied in the Mississippi levee districts and the Sacramento River flood-control districts. The findings of such a commission should receive the united support of water users along the Lower Colorado, if there is a reasonable degree of willingness to get together on common ground. Moreover, the report of such a commission would constitute the logical starting point for an international commission to draw up some form of agreement to which both the United States and Mexico would subscribe.

The foregoing suggestion is based wholly on economic considerations. For the good of the country at large, and particularly for those interests concerned with the control of the Colorado River, some such plan should be adopted at the earliest possible moment.

Federal Aid and Co-operation in Rural Public Health Work

THERE has been introduced in Congress by Mr. Lever a bill to provide means for the prevention, control and mitigation of the diseases of our people living in the country and in towns of not more than 5000 population. The United States Public Health Service is designated as the agency of the Federal Government in this work, and the states are to be represented by their health departments or officers. The bill carries an appropriation of $480,000 annually to be allotted $10,000 to each State, besides an appropriation of $250,000 for the current fiscal year, $500,000 for 1920, $750,000 for 1921, and $1,000,000 annually after 1921. After deducting administration expenses, not exceeding $50,000 annually, from the appropriations, the annual Federal contributions are to be divided among the states in proportion to their areas and to their rural populations, one-half on each basis. In order that any state shall receive any of this money, it must first give official assent to the law and agree to furnish an equal sum from its own funds, after the current fiscal year. The regulations governing the co-operative work are to be drawn by the Secretary of the Treasury, just as the Secretary of Agriculture draws the regulations governing the laws of this type now in force.

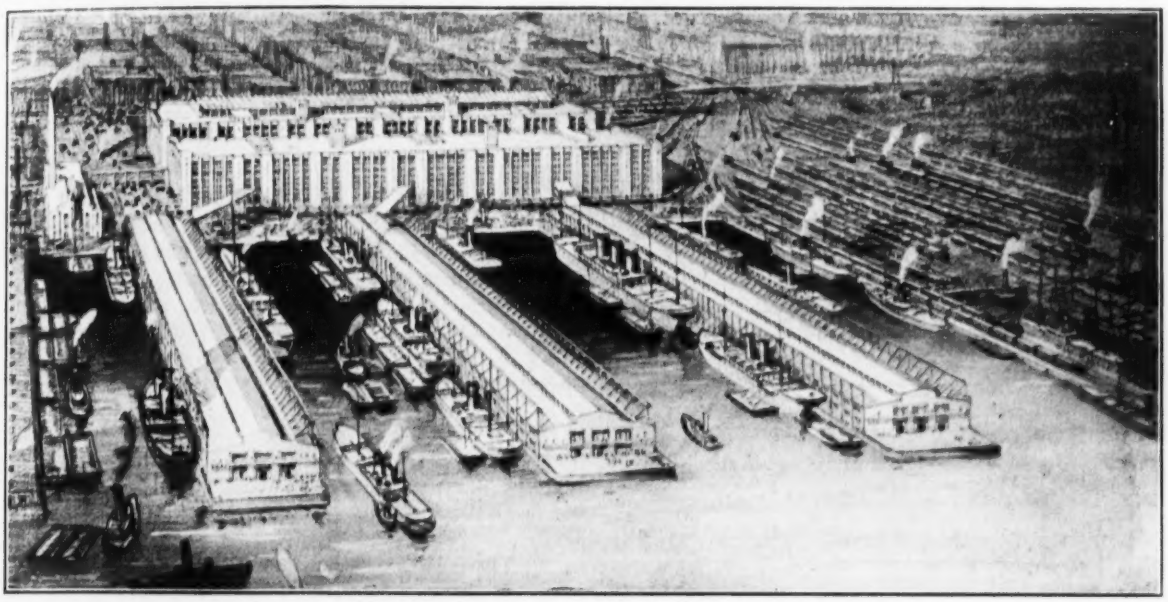
The importance of this act is capable of numerical demonstration, and does not rest on generalities. Its objects will be attained when the people in the country and in the little towns know what they can do to protect themselves against disease and apply this knowledge, thereby eliminating the diseases which are now common but which should be matters of medical history. Our large cities have gone a long way toward that desirable end. The cities in the states maintaining public health registration service had their death rates decreased an average of 21.2% in the period 1900-1912, while the death rate in the rural sections decreased only 8.6 per cent. The last typhoid-fever census figures were taken in 1900 and showed that even that disease, peculiarly likely to occur in cities, was actually more prevalent in the country, outside New England. The Public Health Service estimates that as a result of unsanitary conditions in the country and in the small towns there are 350,000 cases of typhoid annually in such sections, with about 30,000 deaths. There are about 9,000,000 cases of malaria and 3000 deaths. The service estimates that the economic loss from these two causes in the country is about $900,000,000 annually. Then there is the hook-worm disease, also due absolutely to unsanitary conditions. There are about 2,000,000 cases of this, and some of them are fatal. Economists have not yet reached a satisfactory estimate of the financial burden of this disease, because persons afflicted with it have their working value reduced from one-fourth to one-half, so that any estimate of the financial burden due to the disease must be far less accurate than that for typhoid or malaria. The detail figures have recently been made public, in part, in Bulletin 94 of the Public Health Service, so it is unnecessary to go into them here.

The bill is specially interesting to the sanitary engineer in that, if it is passed, it will enable him to have the support and coöperation of a fairly efficient rural health organization, wherever his work may be done. The Public Health Service is coöperating in some places with the county agents working under the Lever act of 1914, because of the inadequate provisions made in such localities for local health work. The typhoid and malaria brought to the cities annually by persons who have been spending their vacations in the country give the urban resident a very strong reason for backing this proposed law. The sanitary engineer who is trying to force the innumerable little towns of the country to clean up and stay clean will find in this proposed legislation the help he has heretofore sought in vain. There is nothing spectacular about these small local skirmishes with filthy and slovenly conditions; they have none of the interest of the engineering problems of the larger cities. But they are of great collective importance, and call in many cases for just as much good judgment and engineering ability as larger operations, so that the Lever rural health bill, as it is called, is really a measure of unusual significance to a very large group of engineers who are rendering the same valuable class of service that is performed by the country doctors.

Brooklyn Army Base Is Largest Port Terminal

Huge Freight-Handling Unit Designed for Overseas Service Has 138 Acres of Pier and Warehouse Floor and Track Space for 1300 Cars—Designed as a Whole for Rapid and Economic Operation

THREE deep-water piers, each larger than any other pier in New York harbor, a small lighterage pier, two reinforced-concrete warehouses with 91 acres of storage floor, and railway yards accommodating 1300 cars, make up the huge Army base which was rapidly approaching completion in Brooklyn, N. Y., when the armistice was signed. Begun in May, 1918, the whole terminal would have been well toward completion by the end of the year had not the return of the eight-hour day, following the armistice, precipitated strikes which cut down the output. As it is, the buildings and one pier are now nearly ready for service. About $17,000,000 had been paid out in the nine months up to Feb. 10, which puts the operation near the head of the concentrated building constructions incident to the war.



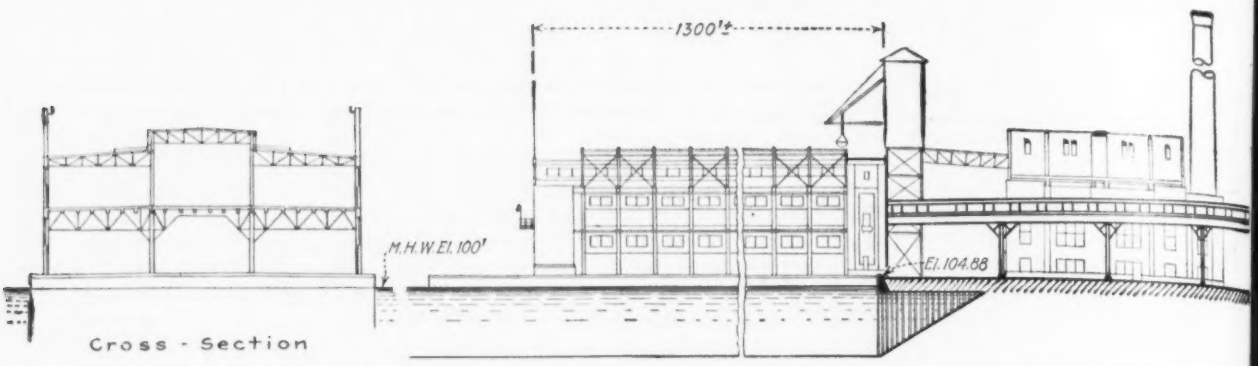
PERSPECTIVE OF FINISHED BROOKLYN ARMY BASE FROM THE WATERSIDE LOOKING SOUTH

Individually, any one of the units which make up the Brooklyn base is a large and important engineering structure worthy of detailed description. Collectively, the whole project is a remarkable example of a modern freight-handling port terminal, a necessary shipping element hitherto rare in this country. The attention of this article, therefore, will be mainly directed to the composite design of the base rather than to those structural details which in so enormous an undertaking would require space far beyond that available here.

The Brooklyn Army base is the largest and in many ways the most nearly complete of the six port terminals built in 1918 to handle the supplies to the American Army in France. Soon after the United States entered the war a committee of the Council of National Defense, in coöperation with the War Department, made a thorough study of the storage and traffic necessities, as a result of which they recommended the establishment of a series of interior and ocean terminals which would insure a steady flow of the needed materials to France. For one reason or another, however, the port terminals themselves did not get under way until nearly a year after the war was started. Few of them were in operation at the time of the signing of the armistice. Their design was predicated on a war use, which meant primarily that the material through them would flow mainly from land to the ship. Where any question of alternative design arose, the war use naturally controlled, but in the permanent terminals of the Boston and Brooklyn type the possible future peace-time use was always kept in mind.

The terminal is located on the east shore of New York Bay, immediately alongside of the harbor terminal of the Long Island Railroad, with its car-storage tracks and car-float bridges permitting transfer to and from any part of New York harbor. Here an area extending 1560 ft. along the waterfront and 1305 ft. back of the main bulkhead line was taken over by the Government. This extends from Second Ave. to the bay; the total land and water area of 100 acres (including the cross streets and First Ave.) is all inclosed in the Government reservation.

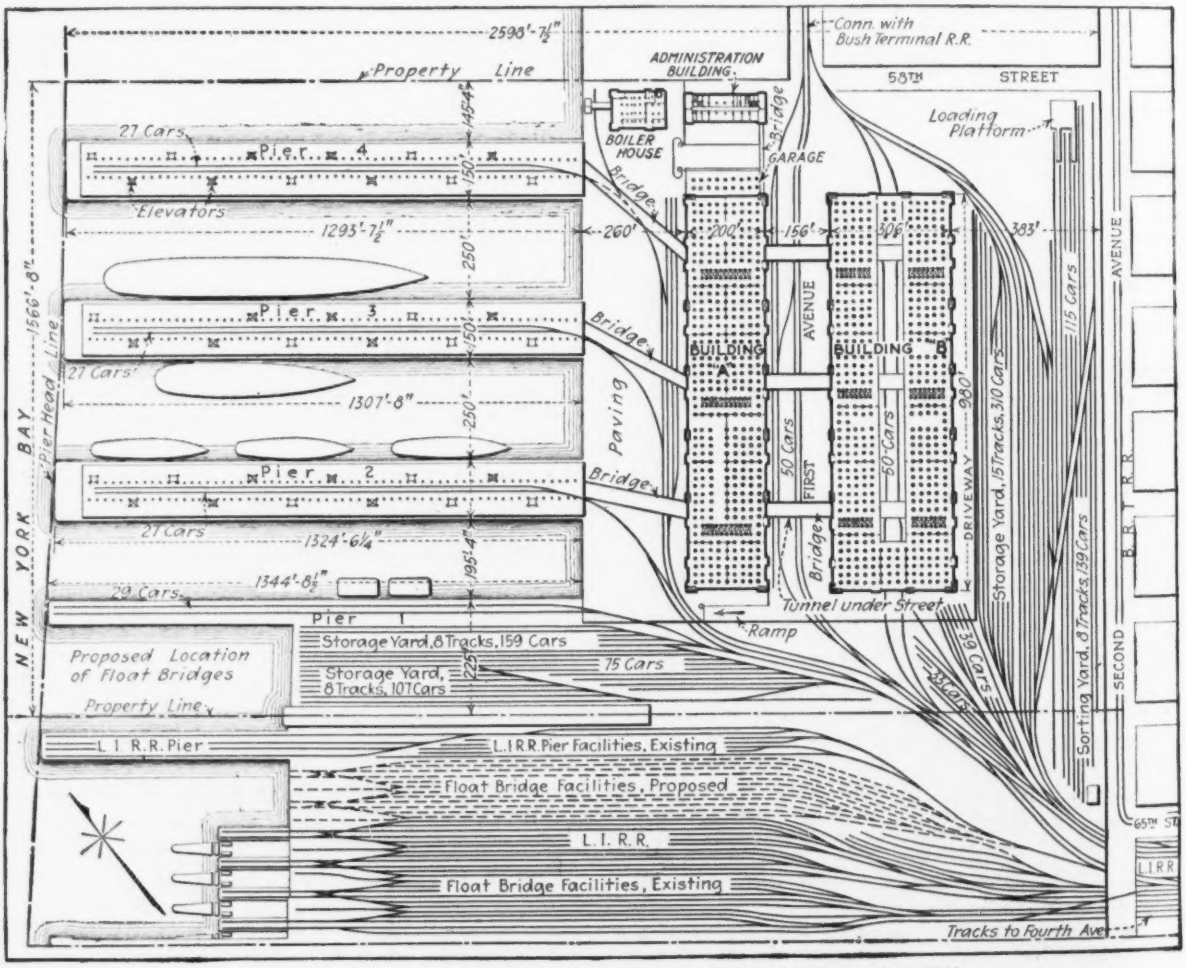
As shown in the accompanying map and plan of the base, the terminal consists essentially of two large reinforced-concrete warehouses connected by tunnels and bridges, approached by railroad tracks and paved streets, and further connected by a paved area and bridges to three double-deck piers, each 150 ft. wide



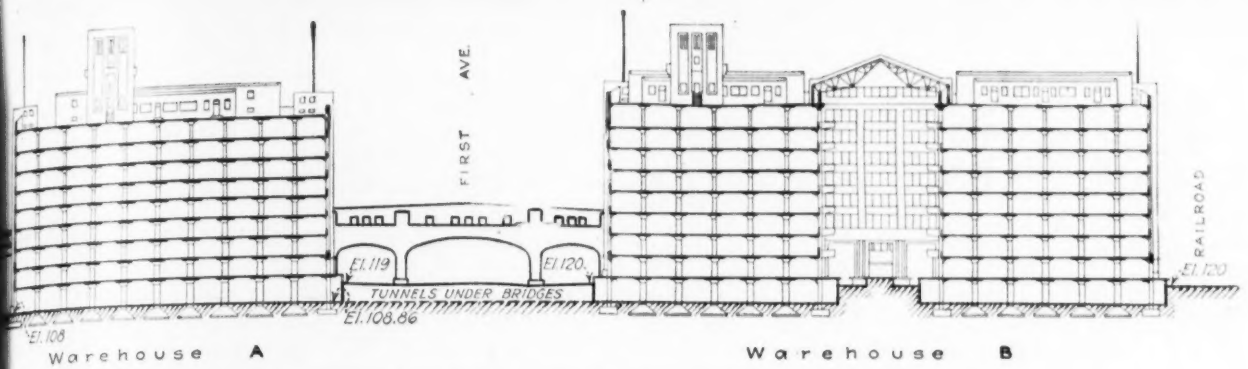
CROSS-SECTION THROUGH THE BROOKLYN ARMY BASE SHOWING, FROM THE LEFT, ONE OF THE 1300-FOOT PIERS, WAREHOUSE B, AND WAREHOUSE

and varying in length from 1294 to 1325 ft., the variation being due to the fact that the pierhead line is not parallel to the bulkhead line. There is in addition a 60-ft. lighterage pier 1345 ft. long on one side and about 600 ft. on the other, and the necessary administration building and boiler house. Tracks paralleling the warehouses and the slips at the south end of the site provide storage for cars. South of the site is the large storage yard of the Long Island R.R., connection to which is made at the southeasterly end of the site. Track connections at the north end of the site lead to the Bush Terminal railroad. The slips, with a maximum width of 250 ft., are dredged to a depth of 35 feet.

The warehouses are of reinforced-concrete construction throughout and of similar structural design. Building A, the one nearest the wharves, is 200 ft. wide and 980 ft. long, and eight stories and deck story



PLAN OF THE NEW ARMY BASE ON NEW YORK HARBOR AT BROOKLYN



THE BRIDGE CONNECTING THE PIERS TO WAREHOUSE A, FIRST AVENUE, AND THE BRIDGE CROSSING TO B WITH THE RAILROAD YARD

high. It has a floor area of 41 acres. Building B is 306 ft. wide, 980 ft. long, and has eight stories and basement. Its floor area of 50 acres makes it the largest concrete building. It has an interior court 66 ft. wide, covered over with a steel and glass skylight, and provided with concrete track girders on which run girder cranes controlling the freight on the cars which run through the court. Extending out from the windows of the court at each floor are concrete balconies onto which material is loaded for transfer to or from storage on the floor. These balconies are staggered in plan so as not to interfere with each other. The two buildings are connected by three lines of bridges at the third floor and tunnels at the basement of warehouse B to the dock floor of warehouse A, all being in direct line with bridges leading to the piers.

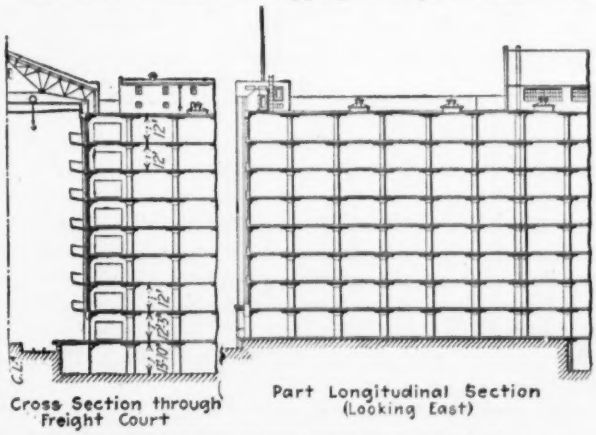
Both buildings are of the two-way flat-slab type, with round, spirally reinforced columns. The curtain walls are of concrete throughout. Intermediate partition walls, located as shown on the typical floor plan, are also of concrete. The design of these buildings is in accordance with the local city regulations and the provisions of the National Board of Fire Underwriters. The first, second and third floors are designed for a live load of 300 lb. per square foot and the upper floors for 250 pounds.

Building A is supported on reinforced-concrete spread footings, using a total safe load of 3 tons per square foot, with the exception of a small part of the building where a continuous mat footing was used on account of poor soil. Building B has the same type of foundations except at the north end, where Raymond concrete piles were used to eliminate the excessive excavation that would have been required for spread footings. Each of the buildings is divided into four separate parts by three expansion joints, their location being determined by storage space requirements and elevator groupings, but in general being about 300 ft. apart.

Outside stairways are provided in pylons, according to fire-protection standards, and the windows are all wire glass, those having exposure being of the Underwriters' type. Architecturally, the buildings are fairly simple, but the general effect is remarkably fine. The tremendous emphasis of so great a pile as either of the warehouses cannot be escaped in any part of the site. This effect can only be partly implied by the photographs of them which are reproduced herewith.

The three main piers are identical in design and size, except for the slight variation in length. They are 150 ft. wide and from 1294 to 1325 ft. in length, and carry over practically all of their area a double-deck shed, with first-floor tracks and roadway connecting with the main level of the yard, and the second floor connecting by simple plate-girder steel bridges to the third floor of building A, where they enter in front of the elevator banks. Slips 250 ft. wide are dredged to 35 ft. now, and in one case to 38 ft., but the substructure will permit the 40-ft. New York harbor standard.

The substructure follows the design of similar piers in the New York district; that is, untreated wood piles carrying, above the water line, timber caps and a reinforced-concrete slab deck, with pile clusters capped at mid-tide for the pedestals under the columns. A departure from local practice was the design and construction of the concrete deck as a continuous slab instead of in sections stopping over pile bents. The



DETAILS OF PARTS OF WAREHOUSE B

early practice had been adopted because of fear of unequal settlement of the bents and consequent severance of continuity, but the present designers were willing to assume this continuity, with a consequent saving in steel.

Structural design of the pier superstructure was made at a time when there was the greatest demand

for saving in steel, particularly in plates, which were needed for ships. The resulting design, therefore, does not follow current practice, nor is it advanced by its authors as the best possible under normal conditions. Its main difference is in the use of longitudinal concrete stringers and wood roof purlins, as a part of a structural steel frame, the unusual arrangement of the middle-bay cross frames, and the use of a side-bay truss instead of a girder. All of these details saved steel, especially plate steel, the claim being that in each pier the saving in plates over normal design was enough to build one ship.

Each shed is in three continuous bays for the full length of the pier. The second floor, a concrete slab, is supported in the outer bays in trusses with longitudinal girders of reinforced concrete supported on brackets on the steelwork and in the middle bay on a cantilevered frame, of which the supporting members are trusses and the suspended members a Bethlehem 26-in. girder 20 ft. 8 in. long. The roof, with a center bay monitor, is a light steel truss carrying wood purlins and sheathing with tar roofing. Outside columns rise above the roof and carry the longitudinal beams from which freight-handling hoists are hung, according to local practice. All openings in both decks have metal doors which slide back under the ceiling.

Loadings of 500 lb. per square foot on the first deck and 300 lb. on the second were provided for.

Between the piers extends a bulkhead which consists of a concrete wall resting on a pile and timber platform, and retaining about 10 ft. of fill some 25 ft. out from a row of sheet piling.

Full provision has been made for the lighting, heating, drainage and water-supply of the entire base, an engineering operation of considerable magnitude but of no particular complication. Warehouses and piers are all provided with sprinklers and high-pressure service lines, as well as connections to the pumps in the boiler house. Light and power are purchased from the local service company, but all heating service comes from the central boiler house. The administration building is a reinforced-concrete structure of the office type connected by a bridge to warehouse A.

The pavements in the base are of three types, depending on traffic conditions and considerations of laying. Granite blocks are laid on First Ave. and on the streets south and east of the warehouses and on the ramps between First Ave. and the bulkhead. Bitulithic pavement is to be laid in the area between building A and the bulkhead, and asphalt block will be used on the first deck of the piers, on the bridges to the warehouse A, and over First Ave., and on the loading platforms and main traffic aisles in the warehouses. Concrete floors in buildings and on the second floor of the piers have a 1-in. granolithic surface. Quantities are 47,000 sq.yd. of granite block, 44,000 sq.yd. of bitulithic, and 104,000 sq.yd. of asphalt block.

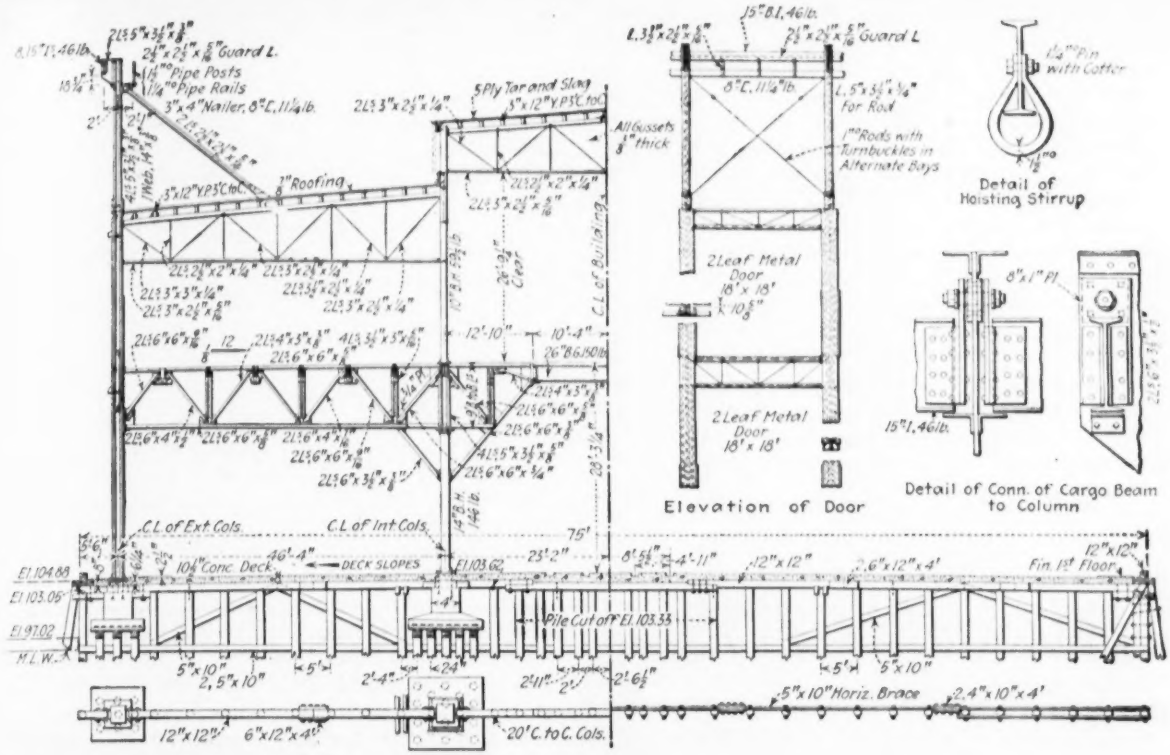
Granite blocks are laid under standard New York specifications, on a 2-in. sand bed over a concrete base. Each block is about 5½ in. deep, except in track areas, where it is 4 in. deep and is laid on a 1-in. sand cushion. As the tracks are laid with a T-rail instead of the usual girder rail, the blocks adjoining the rail have a flanged groove cut 2½ in. deep. Expansion joints are placed transversely over the pavement every 50 ft. and over the edges of the tunnels between buildings. The base in all cases is a 1:3:5 gravel concrete 6 in. thick without expansion joints. The blocks are grouted with a 1:1 grout.

LOOKING EAST FROM LONG ISLAND TERMINAL TOWARD BUILDINGS NEARING COMPLETION

Bitulithic is the standard pavement made by the Warren Bros. Co., and has an 8-in. concrete base. Asphalt-block pavement on the piers is made up of 5 x 12 x 2-in. block made by the Hastings Pavement Co. This pavement is laid on a base prepared of moist 1:3 grout ¾ in. thick and struck to a plane surface.

As an indication of the tremendous size of the whole project, a few of the total figures are given in the accompanying table. (See page 322.)

As stated at the beginning of this article, the fundamental design of the terminal was made to insure the even flow of freight to the outgoing ships. To this end the warehouses are in effect reservoirs for the storage of such freight as cannot be transferred immediately to the ship. A direct and readily usable connection between the warehouses and the piers had therefore to be provided, at the same time permitting

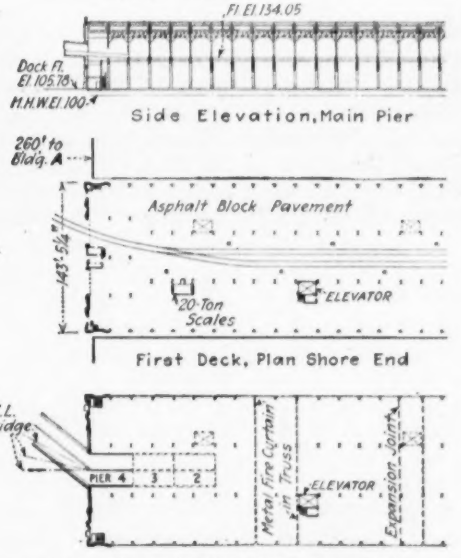

Detail of Hoisting Stirrup
Detail of Conn. of Cargo Beam to Column
Elevation of Door
2 Leaf Metal Door 18' x 18'
2 Leaf Metal Door 18' x 18'
C.L. of Ext. Cols.
C.L. of Int. Cols.
104" Conc. Deck
DECK SLOPES
Pile Cut off El. 103.33
5"x10" Horiz. Brace
20' C. to C. Cols.
Fin. 1st Floor

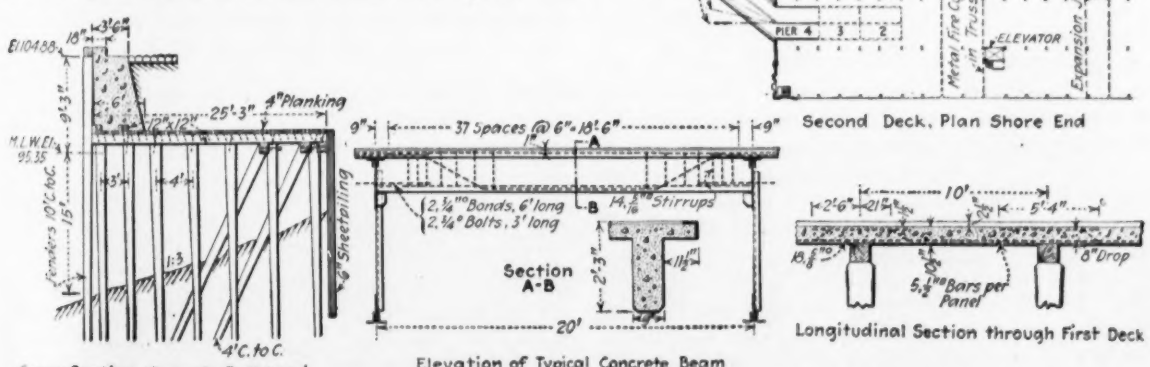
Half Section of Shed and Section and Plan of Substructure at Column Footings

Half Section and Plan of Substructure between Column Footings

an alternative loading or unloading of freight direct to the piers or its temporary storage in the warehouses whence it is to be rehandled. Two definite traffic levels are provided, the lower being the level of the first deck of the main piers, the open area between building A and the water, the lowest or dock story of building A and the tunnel connecting buildings A and B and the basement of building B. At an elevation two stories above it is the second deck of the pier, the bridges from the piers to building A, the third stories of the warehouses, and the bridges between them. At an intermediate level is First Ave. between buildings A and B, which is connected by ramps to the bulkhead areas.

Entering freight, therefore, will come either via railroad or on truck. Railroad cars can be brought either over the car floats to the Long Island yard, from the Bush Terminal at the north, or from the yards of the Long Island R.R. at the east, which yards can




Cross-Section through Bulkhead
Elevation of Typical Concrete Beam
Section A-B
Longitudinal Section through First Deck
37 Spaces @ 6" = 18'6"
2, 1/4" Bonds, 6' long
2, 1/4" Bolts, 3' long
14, 5/16" Stirrups
5, 1/2" Bars per Panel
8" Drop

DETAILS OF ONE OF THE LARGE DOUBLE-DECK PIERS, ARMY SUPPLY BASE, BROOKLYN

be reached via any of the car floats to Long Island or the Hell Gate bridge from the mainland some miles north. Railroad cars stored in the various storage yards can be switched onto the tracks adjoining the east side of building B, in the court of building B, along the center of First Ave., along the east front of building A, or directly onto the first deck of the piers. Trucks will all enter the site from the main entrance at the northwest corner. They can be drawn up along all sides of building B, or on the east side of building A, or they can run down the ramps to the pier level and either approach the west side of building A at its dock floor level there or be run directly onto the first deck level of the piers themselves.

The loading and unloading platforms of the terminal will accommodate a total of 129 cars, and on the bulkhead space west of building A, in addition to the loading and switching tracks, two storage tracks are

LOOKING NORTH TOWARD BUILDING B OVER RAILROAD YARD, BROOKLYN ARMY BASE

provided, accommodating 36 cars in storage, which can be unloaded by derricks onto the bulkhead space if necessary. Each pier is provided with two tracks, 1200 ft. long; allowing 50% empty for traffic requirements, these will accommodate 28 cars each, or a total of 84 cars on the three piers. The completed yards will include about 17 miles of track and 172 switches, and will provide storage for a total of 1300 cars.

The standards followed in the track work are those of the United States Army and the Director General of Military Railways. Eighty-pound steel rail of the A. R. A. section is laid on all curves and through turnouts and on drill tracks and leads subject to much traffic. The balance of the yard will be laid with 67½-lb. Russian rail, which was rolled for the Russian railways and which, after the Russian revolution, was diverted for use in this country. No tie-plates are used, but all curves are double spiked. The maximum curve is 300-ft. radius except one instance at the First Ave. connection, where a curve 274-ft. radius is used. Within paved areas granite block is to be laid between and outside of the rails, and ground levers are to be used at the switches. The ballast is cinders 6 in. deep under the bottom of the tie.

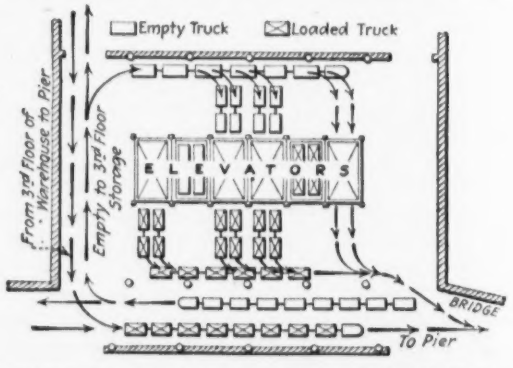
The truck-unloading platforms of the warehouses will accommodate 228 motor trucks, and in addition, freight may be delivered direct to the piers by truck. Furthermore, of course, lighters may be unloaded along the 60-ft. pier.

In the expected operation of the terminal, the two general traffic levels will be the main arteries of traffic

Item	Buildings	Piers	Misc.	Total	Unit
Land area of reservation				57	Acres
Water area, including that occupied by piers				43	Acres
Area occupied by building and piers	12	15		27	Acres
Land excavation				704,000	Cu yd
Dredging				1,700,000	Cu yd
Total floor area	4,699,000	1,220,000	40,000	5,959,000	Cu yd
Timber and lumber, construction use, forms	6,614,000	1,500,000	600,000	8,714,000	Ft b.m.
Cement	381,200	67,500	51,000	500,000	Bbl
Sand	138,000	3,000	15,000	156,000	Cu yd
Stone	194,100		20,900	215,000	Cu yd
Mixed aggregate		71,000		71,000	Cu yd
Grits	11,000	3,000		14,000	Cu yd
Concrete	214,600	41,700	26,900	283,200	Cu yd
Reinforcing steel	13,650	1,900	450	16,000	Tons
Structural steel	425	9,070	1,005	10,000	Tons
R.R. track, storage capacity (including railroad track on piers)				20	Miles
Railroad track, storage capacity				1,300	Cars

and the other floors will be used entirely for storage. All material will be moved from truck or railroad platform to elevators by industrial trucks and trailers, from the elevators to the required storage floor, there to be placed by tractors and trailers. In rehandling, all material will be taken from its storage location by elevators to one of the two traffic levels, and thence carried to the pier for unloading. Special provision in the court of building B is made for the handling of packages from the freight cars or trucks to the staggered balconies shown on the drawing. Onto these balconies may be run the small trailers, and the materials dropped onto them from the traveling cranes. No provision for outside handling of freight to different floors is made on building A, except that the tracks west of the building are so close as to permit unloading of cars on them by whip hoists which can be put on the roof of building A.

A total of 90 freight elevators is to be provided in the various buildings and piers. Building A has three



DETAILS OF OPERATION OF TRACTOR TRAILERS AT ELEVATOR IN WAREHOUSE

groups of ten each and building B six groups of seven each. There are, besides, one passenger elevator in building A and two in B, with provision for four in each.

As shown in the drawing, the elevators are arranged in three groups, at the ends and middle of each of the buildings. These elevators are of 10,000-lb. capacity traveling 150 ft. per minute, and have 9 x 17-ft. clear floor space. They are so designed as to accommodate four trailer trucks at one time. They are to be open at both ends to permit of through circulation and so as to prevent interference and congestion of traffic.

The elevators are of the special central-control type which has been used in several of the Army bases; that is, they are provided with an auxiliary mechanism which automatically levels the car floor at the level of the warehouse floor. A special dispatch central located in each building will have full control of all of the cars in the building.

On each of the three covered piers there are six elevators with a provision for six additional, to be installed at some future time. In addition, provision is made for spiral chutes from the second to the first deck.

In general, all traffic movements in the buildings and piers will be made by trailer trucks drawn by electric tractors. The average load of each trailer will be about 1500 lb., and they will be drawn in trains of from four to eight trailers in a train. At each floor, when receiving and discharging are in progress, there should be a continuous movement of loaded trucks in one direction and empty trucks in the other, between the point of loading or unloading and the elevators. The trucks will then be placed on the elevators and make continuous trips from point of loading to point of unloading and return—as, for example, for a storage space on an upper floor to the pier—but the tractor will move generally from point to point on its own floor. This results in three main circuits of travel for each group of elevators, proceeding simultaneously: (1) Between unloading platforms and elevators on the first floor; (2) between elevators and piers on the third floor; (3) between storage spaces on the upper floors and the elevators.

Normal Operation of Base

Normal operation of the base at a freight-handling unit is intended to be as follows: Incoming freight will be loaded on trailers and drawn by trucks to the elevator on the first floor. The door will then be closed and the car dispatched to the upper floor on which the goods are to be stored. When it reaches that floor the doors will be opened automatically, the trailers will be moved off by a tractor on that floor and replaced with empties. The doors will then be closed by the pressing of a button and the car returned to the first floor by the pressing of the dispatch button. Outgoing freight will be handled in similar fashion, the elevator with empty trucks being dispatched from the third floor to the loading floor, and the loaded elevator returning to the third floor. Special devices, of course, are provided whereby the elevators may be manually controlled, at which time the central dispatch system is thrown out of gear.

It is difficult to give full credit to all who are responsible for the rapid and effective construction of this mammoth project. The credit for initiative for its location and design should probably be given to Irving T. Bush, of the Bush Terminal Co., who early in 1917 began to study the problem of a big terminal in New York harbor. Its design was made by Cass Gilbert, New York architect, under the direction of Maj. Gen. G. W. Goethals, U. S. A., director of storage and traffic of the Army. The construction was carried out under the direction of the Construction Division of the Army, Brig. Gen. R. C. Marshall, Jr., chief of the division. The Turner Construction Co. of New York City is general contractor. In an organization chart prepared by the general contractor there are listed 36 separate subcontractors and fully a hundred responsible engineers and contractors' superintendents. In charge of the work for the Army as constructing quartermaster is Lieut. Col. H. S. Crocker, Quartermaster Corps, who before entering the service was a well known engineer of Denver, Colo. A. C. Tozzer is executive manager at the Army Base for the Turner Construction Company.

Canal Seepage Losses Are Affected by Temperature

Records Kept on Western Irrigation Project Show Increase of Losses with Warmer Water

By Lynn Crandall

Chief Hydrographer Twin Falls North Side Land & Water Co. Jerome, Idaho

THE effect of temperature on canal losses has not always been fully appreciated in studies made in the past, but it is a fact that the variation in temperature during the irrigation season may readily cause a 30% variation in the rate of seepage losses. The results of seepage investigations made early and late in the season must be considered in connection with water temperatures if information is desired regarding the loss at the time of maximum demand. In connection with detailed hydrometric investigations carried on for the past two years on the project of the Twin Falls North Side Land & Water Co. in southern Idaho, a fairly definite relation has been worked out between water temperatures and rate of loss; it is shown in the accompanying diagrams.

Fig. 1 shows the average monthly rate of loss over the entire canal system, comprising some 2600 acres of water surface. The results are based on daily records of use and supply, computed separately for each of the several hundred laterals on the project. The decreased rate of loss during 1917 compared with 1916 was probably due to the unusually silty character of the water during 1917. During August, 1917, when the demand was supplied almost entirely from storage, the water was quite clear and the rate of loss was the same as in 1916.

The losses are expressed in terms of depth lost per day over the water surface area, instead of the wetted perimeter, as commonly used. The water surface area is the easiest to determine, and probably the loss varies more nearly in proportion to it than to the wetted perimeter, as for conditions in ordinary canals the loss is mostly due to the action of gravity. For ordinary conditions on the North Side project the canal widths are about 5% less than the wetted perimeters, so the losses shown on Fig. 1 would be about 5% less if expressed in terms of the wetted perimeter.

Two storage reservoirs, Wilson Lake and Jerome Reservoir, are located on the tract. Wilson Lake, when full, covers an area of 1400 acres, with a storage of 18,000 acre-feet. Jerome Reservoir, if filled, would cover 5800 acres, with a storage of 60,000 acre-feet. On account of the excellent underground drainage, it has been impossible to build up the ground-water table underneath these reservoirs, and the present loss is nearly as

great as in ordinary canals in the same kind of material. This has rendered the reservoirs practically worthless for storage purposes. Wilson Lake is generally filled at the beginning of the irrigation season and used as a regulating basin for several months, but with the approach of the peak of the irrigation demand the large losses make it necessary to draw all water out of the reservoir and use it as a canal channel. No attempt is now made to fill Jerome Reservoir, but it has to be maintained at an elevation covering 400 acres, in order to furnish water to canals below.

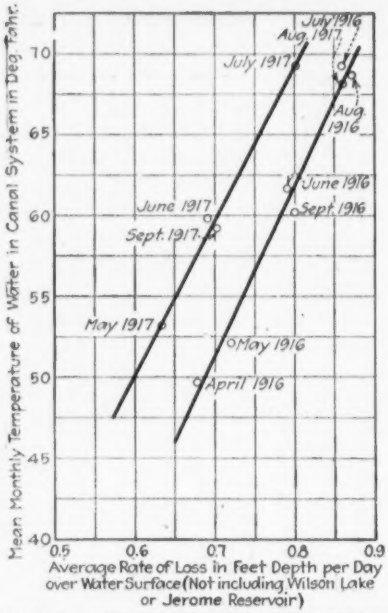
Fig. 2 shows the losses for different water temperatures at various stages of Wilson Lake and at the height at which Jerome Reservoir is maintained. For the same depth of water the loss is somewhat less in Wilson Lake than in Jerome Reservoir, and the losses in the former increase rapidly with increasing depths. This is probably due to the fact that the bottom of Wilson Lake is largely composed of lava rock, which is more impervious to the passage of water than the deep, fine, sandy loam soil in the bottom of Jerome Reservoir and at the high elevations in Wilson Lake.

An interesting comparison between the seepage losses on the tract and the results obtained from ground-water flow formulas is given in the accompanying table:

TABLE SHOWING RATE OF LOSS AT VARIOUS TEMPERATURES COMPARED WITH RATE OF LOSS AT 45 DEGREES FAHRENHEIT

Water Temperatures	Ratio of Loss to Loss at 45°		
	50°	60°	70°
Hazen formula for ground-water flow	109%	128%	146%
Schlicter formula for ground-water flow	107	125	143
Loss in North Side Canal system, not including reservoirs; average, 1916-17	108	125	141
Loss in Jerome reservoir; maximum depth, 17 ft.	123	173	218
Loss in Wilson Lake; depth, 10 ft.	114	132	165
Loss in Wilson Lake; depth, 15 ft.	118	148	182
Loss in Wilson Lake; depth, 20 ft.	122	158	192
Loss in Wilson Lake; depth, 25 ft.	126	166	200

It will be noted that the actual canal seepage losses agree very closely with the results from the Hazen and Schlicter formulas for ground-water movement, but that the losses in the reservoirs show a greater proportional effect of temperature with increasing depths of water.


Mean Monthly Temperature of Water in Canal System in Deg. Fahr.
July 1916
Aug. 1917
July 1917
Aug. 1916
June 1916
June 1917
Sept. 1916
Sept. 1917
May 1917
May 1916
April 1916
Average Rate of Loss in Feet Depth per Day over Water Surface (Not including Wilson Lake or Jerome Reservoir)

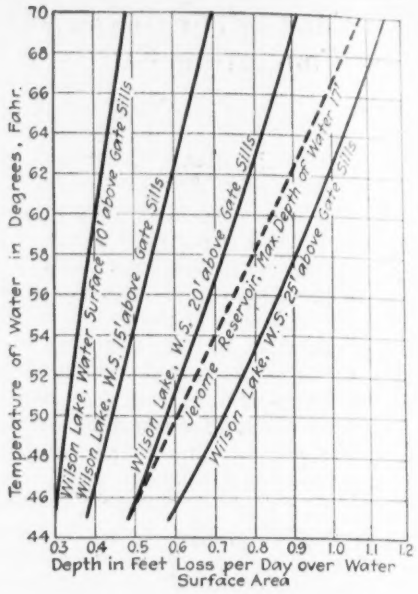

Temperature of Water in Degrees, Fahr.
Wilson Lake, Water Surface 10' above Gate Sills
Wilson Lake, W.S. 15' above Gate Sills
Wilson Lake, W.S. 20' above Gate Sills
Jerome Reservoir, Max. Depth of Water 17'
Wilson Lake, W.S. 25' above Gate Sills
Depth in Feet Loss per Day over Water Surface Area

FIG. 1. RELATION BETWEEN SEEPAGE LOSSES AND WATER TEMPERATURE IN CANAL SYSTEM. FIG. 2. RELATION BETWEEN SEEPAGE LOSSES AND WATER TEMPERATURE IN WILSON LAKE AND JEROME RESERVOIR

British Shipbuilding Below Production of 1913

Ship production in Great Britain during 1918 (in the year which ended Oct. 31) reached 1,600,000 tons, according to a statement of the Parliamentary Secretary of the Ministry of Shipping in the House of Commons Nov. 14. This is below the output reached in 1913, the kingdom's greatest shipbuilding year, when the production was 1,900,000 tons. The tonnages for four years, 1914-1917, are 1,700,000, 650,000, 540,000 and 1,200,000.

Cement Joints for Water Mains Save Money in Portland, Oregon

PORTLAND cement for making joints in cast-iron pipe is used by the Bureau of Water-Works of Portland, Ore., for all sizes from 6-in. to 30-in., except in some particular cases where it has been necessary to put the main in service without leaving sufficient time for the cement to set.

This practice was begun about three years ago, after a series of experiments, and gave such excellent results that it has been continued. During the past two years nine miles of cast-iron main have been laid, using 19,256 lb. of lead and 27,790 lb. of cement. A pound of cement will go as far as three pounds of lead, according to information furnished by F. M. Randlett, engineer for the bureau. With cement at ½c. per pound, the material for these joints cost $139. The same work would have required 68,390 lb. of lead at 8c. per pound, or $5470, therefore a saving of $5331 in material is shown.

It was thought at first that the labor of making the joints would be materially less for cement than for lead, but as the cement joints have to be kept wet for 36 to 48 hours the labor cost is about the same. In making the joints a small amount of yarn or oakum is first driven, to keep the cement from passing into the pipe. The cement is used neat, and only sufficient water is added to make it hold together while it is being forced into place.

Workmen at first showed considerable antagonism to this method of making joints, possibly because they believed their services might be reduced, but this has been overcome and the men have become skilled in making the cement joints.

Laboratory tests made at the University of Minnesota on cement, lead and metalium joints were noted in *Engineering News-Record* of May 23, 1918, p. 991.

Comparison of Formulas for Computing Parabolic Arcs

Limit of Applicability of Common Formula Defined—Exact Formula Simplified

By Robert C. Strachan
Civil Engineer, New York

In computing the lengths of parabolic arcs covering any considerable range in the ratio of rise to span, the engineer is called upon to reconcile discrepancies between different formulas, and to determine what is meant by a "small" ratio. While these questions may be academic when the actual dimensions do not exceed a few feet, they are of real weight in connection with long-span suspension bridges and transmission lines.

The commonly-used formula for the arc L in terms of the chord c and ratio k (rise divided by chord) is

$$L = c\left(1 + \frac{8}{3}k^2\right) \qquad (1)$$

and usually a cautionary note is added, stating that this is true only for "small" values of k.

Investigation of the derivation of Formula 1 shows that beyond a certain limit, both this formula and the one of which it is an abbreviation are incorrect; the determination of this limit is then of prime importance.

Formula 1 is derived by integrating

$$\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{1}{2}} dx$$

after expanding by the binomial theorem, as follows:

FIG. 1

$$y = \frac{mx^2}{l^2} \quad \therefore \frac{dy}{dx} = \frac{2mx}{l^2}$$

and if L = arc BOA

$$L = 2\int_0^l \left(1 + \frac{4m^2x^2}{l^4}\right)^{\frac{1}{2}} dx \qquad (2)$$

Expanding and integrating, representing the element of arc by ds, we obtain

$$\int_0^l ds = l + \frac{2m^2}{3l} - \frac{2m^4}{5l^3} + \frac{4m^6}{7l^5} - \frac{10m^8}{9l^7} + \frac{28m^{10}}{11l^9} - \ldots$$

Substituting for l its value $c/2$ and for m/c the symbol k, we have, finally, in notation coinciding with that used in (1)

$$L = 2\int_0^l ds = c(1 + \frac{8}{3}k^2 - \frac{32}{5}k^4 + \frac{256}{7}k^6 - \frac{2560}{9}k^8 + \ldots) \qquad (3)$$

The expansion from which results Formula 3 is a legitimate method by which to transform an expression of the form

$$\left(1 + \frac{r}{q}\right)^{\frac{1}{2}}$$

into a series; but the series thus obtained fails to converge if r/q is greater than unity. Applying this criterion to the second term of the binomial in (2), recollecting that x becomes l at the upper limit, we find

$$\frac{m}{l} < \tfrac{1}{2} \quad \therefore k < \tfrac{1}{4}$$

Formula 3 therefore fails to give the true value of L however great the number of terms computed unless k is equal to or less than $\frac{1}{4}$: that is unless the chord c is between the focus and the vertex. The degree of approximation attained in different regions as k varies between 0 and $\frac{1}{4}$ will be considered after deriving a second formula for the length of the arc, the results of which will serve as a basis for comparison.

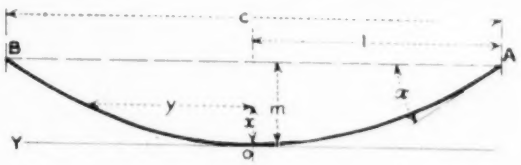


FIG. 2

Referring to Fig. 2, and writing the symbol a for the distance from vertex to focus,

$$y^2 = 4ax \quad \therefore \left(\frac{dy}{dx}\right)^2 = \frac{a}{x} \text{ and } ds = \left(\frac{x+a}{x}\right)^{\frac{1}{2}} dx$$

Hence

$$\int ds = \sqrt{x(x+a)} + a\log_e\left(\sqrt{x} + \sqrt{x+a}\right) + C$$

and

$$Arc\ OA = \int_0^m ds = \sqrt{m(m+a)} + a\log_e\left(\frac{\sqrt{m}+\sqrt{m+a}}{\sqrt{a}}\right)$$

which is equivalent to

$$Arc\ OA = a\left[\sqrt{\frac{m}{a}\left(1+\frac{m}{a}\right)} + \log_e\left(\sqrt{\frac{m}{a}} + \sqrt{1+\frac{m}{a}}\right)\right]$$

From the equation of the curve, $l^2 = 4am$; therefore

$$a = \frac{c^2}{16m} = \frac{c}{16k} \text{ and } \frac{m}{a} = 16k^2$$

After these substitutions have been made the expression for the length of the arc BOA will appear in the well-known form

$$L = \frac{c}{2}\sqrt{1+16k^2} + \frac{c}{8k}\left[\log_e\left(4k + \sqrt{1+16k^2}\right)\right] \qquad (4)$$

which is true for any value of k.

Formula 4 may be made more concise by introducing the hyperbolic functions.

If we denote the tangential angle at A or B by α and its antigudermannian by u, then

$$\tan\alpha = 4k = \sinh u \qquad \sqrt{1+16k^2} = \cosh u$$

$$\log_e(4k + \sqrt{1+16k^2}) = u$$

and the expression for the arc will therefore be

$$L = \frac{c}{16k}(2u + \sinh 2u) \qquad (5)$$

A comparison between the values of L/c obtained from the three formulas will indicate the percentage of error involved in the use of (1) or (3), and the process of obtaining the results will show the greater conciseness of (5).

Example 1. Let $k = 0.2$; then,

By Formula (5)

$4k = 0.8 = \sinh u$, and,

from table, $0.73267 = u$

$1.46534 = 2u$

from table, $2.04901 = \sinh 2u$

$$3.51435 \div 16k = 1.09823 = \frac{L}{c}$$

By Formula (1) *or* (3)

$1 + \frac{5}{4}k^2 =$	1.10667		
$6.4k^4 =$	− .01024	1.09643	3 terms
$36.57k^6 =$	+ .00234	1.09877	4 terms
$284.44k^8 =$	− .00073	1.09804	5 terms
$2606.55k^{10} =$	+ .00026	1.09830	6 terms

Example 2. Let $k = 0.1$; then,

By Formula (5)

$4k = 0.4 = \sinh u$, and,

from table, $0.39004 = u$

$0.78008 = 2u$

from table, $0.86163 = \sinh 2u$

$$1.64171 \div 16k = 1.02607 = \frac{L}{c}$$

By Formula (1) *or* (3)

$1 + \frac{5}{4}k^2 =$	1.02667		
$6.4k^4 =$	− .00064	1.02603	3 terms
$36.57k^6 =$	+ .00004	1.02607	4 terms

Example 3. Let $k = 0.01$; then,

By Formula (5)

$4k = 0.04 = \sinh u$, and,

from table, $0.039988 = u$

$0.079976 = 2u$

from table, $0.080065 = \sinh 2u$

$$0.160041 \div 16k = 1.00026 = \frac{L}{c}$$

By Formula (1) *or* (3)

$1 + \frac{5}{4}k^2 =$	1.00027	2 terms
$6.4k^4 =$	− .00000 . . .	

It appears from these examples that for values of k near 0.01 Formula 1 may be depended upon to the fourth decimal place, and farther as k grows smaller. For values of k near 0.1 Formula 1 is accurate only to the third decimal place; and not less than four terms of the series of Formula 3 must be computed to insure accuracy in the fourth place. For values of k considerably above 0.1 Formula 1 is a comparatively rough approximation, and Formula 3 is cumbersome because of the large number of terms which must be computed to insure accuracy even in the third decimal place. Formula 3 is of course useless for all values of k above or slightly below 0.25.

Formula 1 may then be said to be sufficiently accurate for practical purposes for most cases in which k is 0.01 or less. Formula 5 is preferable whenever k is greater than 0.01, if hyperbolic tables of suitable range are available. If not, Formula 4, which is merely another form of (5) though more time-consuming in its application, may be substituted.

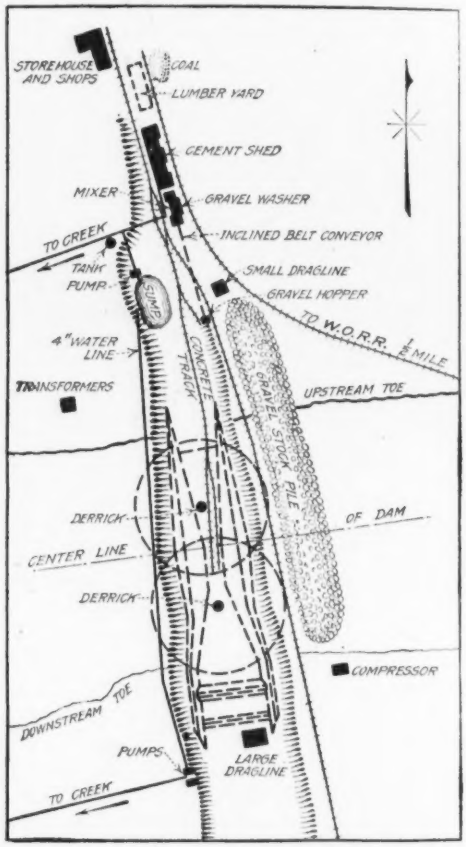
Large Increase in Motor-Truck Traffic

Motor trucks in New York State during the past year increased from 55,402 to 75,268 or 36 per cent., according to Secretary of State Hugo. A similar increase in 1919 would add over 27,000 trucks. Reports state that this will be considerably exceeded. Of the total number of trucks mentioned above about 32,000 are registered from New York City, an increase for the year of 7000.

Mammoth Derricks Build Concrete Outlet for Lockington Dam

Gravel from Excavation Washed and Screened for Concrete — All Operations Mechanical from Pit to Forms

TWO electrically-operated guy derricks of unusual size are concreting the 38,000-cu.yd. outlet and spillway structure for the Lockington Dam of the Miami flood-control works. With 120-ft. masts and 105-ft. booms these derricks cover the full 140-ft. width of the structure and reach its full height of 82 ft, handling both concrete and forms. Concrete is brought by rail to the derricks from a gravel-washing and concrete-



COMPACT LAYOUT KEEPS HAUL DISTANCE MODERATE

mixing plant of the standard type adopted by the flood-control engineers and described in *Engineering News-Record* of Oct. 10, 1918, p. 680.

Lockington Dam is an earth structure about 7000 ft. long, 440 ft. thick at the base and 74 ft. high. The concrete spillway and outlet structures, extending through the embankment, consists of two side walls about 500 ft. long parallel at the center and flaring out at the ends, as indicated by the dash lines on the plant layout map. The walls are 82 ft. high and are 140 ft. apart, out to out. Between the walls is a floor of concrete, and at the center is a cross wall having two 9 x 9-ft. 2-in. openings through which the river waters will normally find outlet The space above the cross wall and between the side walls, which are 82 ft. high, forms the

DERRICKS TOWERING ABOVE WALLS REACH ALL PARTS OF LOCKINGTON DAM OUTLET STRUCTURE

spillway for extraordinary floods. In the plan of construction the cross wall will be built last, so as to afford a clear channel for the stream during the construction of the dam embankment.

Where the concrete spillway and outlet are being built, a remarkably level bedrock occurs only a few feet below the stream bed. Excavation of only a foot or two of the surface is necessary to reach solid rock on which the concrete can be laid. Above the rock is gravel covered with earth. Very little water is carried by this overburden. The gravel, moreover, is entirely suitable, after screening and washing, for use in concrete, and as the channel for the concrete structure is excavated, the earth is piled to one side and the gravel is stored at the other side for future use. A dragline excavator is excavating the channel.

The plant layout for the spillway construction is shown by the map and by the view looking south. Beginning at the north end, the large dragline worked south, excavating the channel, depositing the earth in the west bank and piling the gravel on the east bank. The routine of handling materials and concrete is then as follows: A standard-gage service railway, as shown by the map, runs along the east edge of the cut, and between it and the gravel pile and alongside the gravel hopper of the washing plant. Gravel is transported in 4-cu.yd. dump cars hauled by dinkeys. While the large dragline is still excavating the cut it dumps the gravel directly into the cars, but when the excavation is finished the cars will be loaded from the gravel pile by means of the small dragline.

Gravel cars dump into a ground-level hopper, where a grizzly separates out the large stones, and whence the fine material feeds onto an inclined belt conveyor leading to the screens and washer. The screens separate the washed gravel into coarse and fine gravel and into sand, and discharge each size into a compartment of an elevated bin over the mixer. Close to and in line with the bin is the cement house, to which a service track connecting with the Western Ohio Electric Ry. delivers the cement cars. Structurally the cement house and bins are duplicates of those described in *Engineering News-Record* of Oct. 10, 1918, p. 680, and the mechanical equipment is the same.

The water for washing the gravel is supplied by seepage into the cut. The water which seeps from the north end is collected into a sump and thence is pumped to the screens. If this supply pulls short, water from seepage from the south end is pumped to the sump. All surplus ground water and waste water from the washers are discharged to Loraine Creek, running roughly parallel to the cut and west of it. Water for mixing is taken directly from the line to the gravel washers, and a reserve supply is stored in the tank.

Service tracks of 30-in. gage passing under the mixer discharge extend along the bottom of the cut to the derricks. Three two-car trains hauled by gasoline locomotives deliver the concrete. The cars are small platform cars, each carrying a 1¼-cu.yd. bottom-dump bucket. The buckets are lifted to the forms by the derricks. The derricks also handle the sectional forms and the plum stones which are embedded in the concrete.

Most of the plums are stones separated from the gravel by the hopper grizzly. These stones are hosed clean, loaded into concrete buckets and, like the concrete, are taken by cars to the derricks.

The subsidiary plant, such as the lumber yard, the shops and the compressor house and its rail connections, is explained by the map. Except the dinkeys, all machinery is operated by electricity.

Lockington Dam is a part of the flood-control works of the Miami Conservancy District. Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief ingineer, and C. H. Locher, construction manager. Barton M. Jones is division engineer in charge of the dam.

Opportunities for Chicago Engineers to Work Together

Combined Activities in Actual Practice Needed—Low Wages, Unemployment and Reconstruction Challenge Attention

By C. E. Drayer

Secretary of the American Association of Engineers, Chicago

AT THE onset of the world conflict, business and industry were immediately marshalled by the United States Chamber of Commerce into the most powerful voluntary instrumentality in the United States for winning the war. It kept these forces mobilized for the problems of peace, by the great conference at Atlantic City. Are our engineers big enough to cease weighing progress in the balance of prejudice, and can they get together and do collectively the works of peace with something of the brilliant success of the individual engineer in the war?

Organized to mobilize engineers of Chicago to help win the war, the War Committee of 19 Chicago technical societies must now either disband or direct its activities into channels where they will be useful to the constituent societies in times of peace. In discussing the possibilities of future work, the suggestion was made that the War Committee offer its services to the engineering societies' employment bureau, for the establishing of a branch in Chicago.

The War Committee placed directly, in the six months of its existence, from 50 to 75 men. During the same period the Division of Engineering of the United States Employment Service placed some 5000 engineers, and the Service Clearing House of the American Association of Engineers from three to five men a day. Setting up another engineering employment agency in Chicago would lead, therefore, not to integration but disintegration of existing agencies. This is a step backward. The principle should be *combined engineering organization for effective service to the entire profession.*

All engineering societies are preaching coöperation. Why not put it in plain English and get busy and work together? Only when organized engineering gives employment service in a more effective way than the leeching private agencies can we hope to compete so successfully with them as to put them out of business. Unless we give better service, they will continue to thrive, sucking from the unfortunate engineer who is out of employment from 50 to 60% of the first month's salary. Unless those in charge of the direction of engineering societies do get together and perform employment service, especially in the uncertain times at hand, we shall merit the censure of inefficiency. The need is for even a more vigorous and comprehensive performance than the Division of Engineering was able to deliver.

The argument is that either the Service Clearing House of the American Association of Engineers should be unselfishly supported by all, or all engineers should get unreservedly behind the Division of Engineering of the United States Employment Service, another going organization. Employment must be cared for *now*, and the work must be well done.

Let the War Committee take up some of the many things challenging attention of engineers collectively. The wages of engineers in Chicago have not been raised for 20 years. Here is a job for the 8000 engineers in Chicago. How about the administration of the $60,000,000 bond issue for good roads in Illinois? Why not have an engineer experienced in politics at the constitutional convention soon to be held in Illinois? Where are we engineers to take our place in the great reconstruction problems? Another society employment service in Chicago means "carrying coal to Newcastle," in view of the many things challenging our best efforts.

Another phase of the employment situation involves developing work where none exists. In other words, why should not the engineer be the chief promoter, particularly in the field of public works? If, by spending one dollar for good roads, two dollars are returned to the investing public, why shouldn't the engineer be the first to demonstrate this to his employer, the public? There are other fields for equally profitable exploitation. It is almost a maxim in the business world that, where demand does not exist, it may be created by advertising.

Still another phase of the employment situation concerns the study of salaries that are paid and that should be paid. The profession is being invaded right now by unionism, by the formation of a draftsmen's union as a branch of the American Federation of Labor (see *Engineering News-Record* of Jan. 23, 1919, p. 201). Such things do not happen without good cause. It is probable that hardly any engineers now in union ranks receive as much as $2500 per year, with an average of much less. In other words, the reason seems to be that our engineering societies have failed to face fearlessly the wage-problem phase of the profession, with the result that the men in the lower-paid positions are willing to try another agency.

Here is an indictment of our failure in getting together. How long will the rank and file of the profession permit these conditions to exist?

Pennsylvania Labor Turnover 100 Per Cent. Yearly

In a 10-day period recently 4477 employees left the divisional forces of the eastern lines of the Pennsylvania R.R. and 5122 new ones were hired, stated a bulletin issued by Elisha Lee, Federal manager. The net gain of 645 occurred entirely in the last two days of the period and was apparently sporadic. During the period the number of women employees increased 1545—from 5682 to 7227—while the number of men employees decreased 900. As the total divisional forces had been averaging between 148,000 and 150,000, the bulletin pointed out that the 10-day test indicated a turnover of about 100% per year.

What About the Government Housing Program?

Engineers Should Be Active in Study of Housing in General and of Solution of the Problem of Disposing of Those Government Projects Already Under Way

By Morris Knowles

Chief Engineer, Division of Passenger Transportation and Housing, United States Shipping Board, Emergency Fleet Corporation, Philadelphia

As a necessary war measure, the United States Government about a year ago entered into extensive housing operations which were only partly completed when the armistice was signed. Now that the immediacy of the demand has passed, there is much clamor of one sort or another for the shutting down forthwith of all such operations and the closing out of the whole Government experiment in housing. Engineers have not, as a rule, paid to this problem the attention it deserves. The present article is intended to stimulate thought in the profession which should be most vitally concerned with housing.

Two Government bodies conducted housing operations; one, the Emergency Fleet Corporation, with an appropriation of $75,000,000, for the purpose of housing shipyard workers and their families; the other, the United States Housing Corporation, a bureau of the Department of Labor, with an appropriation of $110,000,000, which has planned towns for the accommodation of munition workers and those engaged in similar war activities other than shipbuilding. The work of these agencies was brought about by a war necessity. Generally, the question was not alone one of improving a sociological condition; men simply could not be induced to work in the munition plants or shipyards where there was a more or less complete lack of houses to live in; and the labor overturns resulting amounted to as much as 700 per cent. per month in some plants. But, as in certain other war-time activities, the results that either have been or may be accomplished by these agencies give promise of solid and enduring benefits in the arts of peace.

What Has Already Been Done

About 90 separate industrial housing projects, to house approximately 150,000 persons, were contemplated by the United States Housing Corporation, and about one-half of these had been placed under contract at the time of the signing of the armistice. Thirty community housing projects are being built by the Division of Passenger Transportation and Housing of the Emergency Fleet Corporation; most of these are complete towns, of from 240 to 7000 contemplated population, while the total population to be served amounts to about 55,000. The aim of these departments has been to create convenient, healthful and attractive living quarters for the workingmen and their families, at an expense consistent with good business judgment. The results, where they have been permitted to come to realization, have been generally in strong contrast to dreary, unappealing laborers' tenements, built in the habitual cramped, stereotyped rows, dingy, squalid, and too often lacking in the first requisites of cleanliness and good sanitation.

The end of the war found these activities with some building work completed, many things accomplished, and much of importance yet to be done. Shortly after the signing of the armistice a resolution was introduced at the convention of the United States Chamber of Commerce, assembled at Atlantic City, which sought to declare in favor of Government abandonment of its housing projects. The United States Senate, anxious to curtail expenditures instantly, provided shortly thereafter in a sweeping resolution. (S. J. Res. 194)

> That the United States Housing Corporation . . . be, and hereby is, directed to suspend work upon all buildings on which it is now engaged in all cases where the construction is not more than 75 per centum completed.

This action was followed by numerous protests, among which is that of the American Civic Association, which by its executive board stated, Dec. 9, 1918:

> The association holds that where these projects are situated in communities urgently in need of additional housing to meet post-war conditions . . . . the proper course for the Government is to complete the projects without interruption . . . . and then to dispose of them in an orderly, deliberate manner; except only in those cases where the Government can clearly obtain a greater net salvage by immediate abandonment and liquidation.
>
> The association further holds that the arbitrary cancellation of existing contracts both with builders' organizations and with public service corporations and municipalities involves a serious economic loss; both actual, in the throwing away of that which has been done; and potential, through loss of expected benefits.

Such protests have been effective in bringing about a substitute resolution of the House Committee, under the same name (S. J. Res. 194), which orders the completion of 24 of the projects and further proposes that the Secretary of Labor make to Congress recommendations and suggestions to meet the demands for homes for the citizens of the United States.

The question now is, Shall Government activities be continued and the initiation of successful management be the goal?

Projects Call for Different Answers

It is evident that different stages of progress in the various housing projects call for separate answers in different places, dependent upon the needs. Many situations exist where the investment is so large and the need of houses still so great, the opportunity for wise management in starting operations so opportune, and the waste so great which would come from stopping now, that good business judgment means the keeping of control until some favorable method and opportunity can be found for sale or disposal otherwise. No general rule can be laid down; the decision must rest upon the facts presented in each case. Surely, the engineer, in his new realization of citizenship, will be not less than alert to his opportunity to promote sound thinking and wise planning for the future, by insisting that the present occasion be used to the utmost to demonstrate

what wise and honest endeavor can do to prevent labor shortage and turnover. It is necessarily a matter of good judgment to determine the nice balance of economics between the salvage to come from abandonment, and the estimated results to come from the sale of completed projects, which in turn demands an intelligent estimate of the need, and the continuance of such need as a post-war condition.

Community Gain the Critical Element

It is unnecessary, even were space available, to present here the case for better housing conditions. Much has been said and written elsewhere on that subject, and it surely will be realized that the question of housing and living conditions is an important one in our future industrial life. The question, then, is not so much whether our Government organization, or one or more of its various agencies, shall save money out of its appropriation; nor is it a question of individual loss or gain. The real question is whether the community as a whole shall realize the full advantage from the already large expenditure made for the Governmental housing developments. In other words, the question is one of loss or gain in economy to the entire country, and not to one of its creatures.

Of secondary importance, perhaps, but none the less of real concern to the engineer, will be the stultifying effect upon the subject of correct housing which surely will ensue from arbitrarily stopping in many places the first comprehensive housing projects to be undertaken in the country on so large a scale. The practical results of many aims are at stake. It is plain, and probably needs no argument, that the projects now started, if abandoned, will now and for a long time in the future present a stumbling block in the particular community, as an example, to be quoted by some, of alleged insecurity and bad policy of the paternal care of labor. Notwithstanding this, there will be many who will think that the work should now be stopped rather than to continue to "sink good money after bad."

Advocates and opponents should not confuse the housing situation with that relating to Government ownership or landlordism, for the question of permanent Government control and management with the necessary acceptance of such paternalism is not before us now; even the most radical are not proposing this. Nor does the advocacy of continuing the present projects until they are going concerns savor of or favor Government ownership of public utilities *per se*. Nor should it be considered as equivalent to the much mooted proposition to continue the control and operation of the railroads, telephone or telegraph lines for the next five years. The former is an undertaking stated to be a war measure for the transportation of soldiers and materials for fighting purposes only; and, in the case of the latter, such facilities were also taken over as an emergency measure, with the understanding that return should take place as soon as the emergency is past. The utilities can be turned back to those agencies, long created and familiar with their duties and with the correct handling of their problems without the necessity for building new organizations. It is not so with housing. New agencies must be established in many cases, and can be successful only after careful and thoughtful consideration, and as a result of some experience. It must be remembered, however, that the danger of Government ownership, operation and control of workmen's homes, without a well considered program being developed, may open the way to a wasteful, political, paternalistic policy respecting certain institutions, industries, workmen and the occupants of the dwellings, and involve practices with regard to rentals and welfare activities which will saddle the Government with a policy not yet determined and approved.

There are, too, differences in the fundamental arrangements among the several projects already started which need careful consideration. For instance, in most of the housing developments of the Emergency Fleet Corporation the shipbuilding company, through a realty corporation, has provided the land without cost to the Government. Thus it has an equity in the proceeding, an interest and a privilege to take over the project and repay to the Government the investment made less the write-off due to excess war cost, as determined by appraisal; such amounts to be paid in 10 annual installments with interest of five per cent.

It is evident from the foregoing that decision should not be reached post-haste or as the results of any preconceived opinions. For instance, a loading-plant in the wilderness, never possible for any other use and perhaps only partially completed, will be considered differently than the shipyard likely to be permanently used in commercial maritime work, and whose need has always been felt and will continue.

What Is the Engineer's Interest?

It appears, therefore, that there is not only at stake a large part of the value of $185,000,000, but also the welfare of an important branch of engineering and its beneficial effects on labor. The interest of the engineer in this proceeding is self-evident. He is interested, first, as a public-spirited citizen in seeing that the community as a whole derives the utmost benefits from the work already done and the expenditures already made. He is also interested in seeing to it that no prejudice results to an important branch of his profession from arbitrary or ill considered legislation.

The determination of whether a given community development should be completed or not, necessarily involves more than consideration of the question of house building, for suitable and adequate facilities for water-supply, sewer, gas and electricity, highways, walks and transportation—all engineering features—are needed to make a town livable. It is no wild flight of the imagination to see beautiful and attractive houses, pleasantly grouped under shady trees, that remain unoccupied because there is a lack of street paving and walks, with failure to grade lots and gutters, resulting in muddy tracking of nice hardwood floors, and also in mosquito-breeding pools in the back yards.

Nor should the engineer be less interested in the complete communal development, such as provision for zoning, stores, schools, churches, and recreation areas, grading of yards, reasonable planting, and the initiation of those neighborhood facilities which promote agreeable social and community life. And it is not answering to say that private initiative, group arrangements by

those who live in a common block, or municipal endeavor, under taxation methods, will be a solution; for the new community finds many ways to use the public moneys and the subscription method is resorted to for many fields, and is usually overdone. In specific cases, however, certain of the group and communal activities may well be left to private initiative, on the basis that something must be left for people to do for themselves.

Too often has the engineer been subordinated in such community planning and development, partly because building houses is the primary purpose and the creation of the architect, which has resulted in a forgetfulness that the engineering questions of street layout, drainage, adequate and safe water-supply and disposal of wastes, are important and vital matters of such an enterprise; and, partly, it must be confessed, because the engineer, with his modesty and desire not to appear too prominent in the discussion of such enterprises, does not let it be known that he, too, is interested in other than plain houses, and that he, too, has a soul and likes to live in attractive, comfortable and convenient community developments.

Constructive criticism should be most apropos. A clear statement, based upon sound business judgment—a matter upon which the engineer should insist—is offered in the following program:

1. A project situated in such a place that during post-war conditions it will fill a demand for more housing facilities, should be completed as promptly as possible.

2. A project where salvage coming from abandonment and liquidation will not exceed the return which would come from sufficiently completing it in an orderly and deliberate manner, should also be completed.

3. The degree of completion must depend in each case upon the facts, and may or may not include all communal facilities. Certain facilities, however, are needed in order that a correct start as a going concern may be obtained.

4. Arbitrary cancellations of projects based only upon percentage of completion, without consideration of other factors, will generally be unwise and uneconomical.

5. Plans for continued operation should, in the absence of a definite Governmental policy, be approached with careful consideration of the influence upon the welfare, both of the worker and of industrial concerns, and possible discrimination, due to the advantageous situation of those favored by Governmental participations, should be guarded against.

6. On the other hand, a belief in complete failure of such endeavors should be avoided, by the institution of a wise program calling for management until a going concern is obtained; with an endeavor to turn over to existing agencies as soon as this result has been gained. Obviously, paternalism must be avoided.

United States Water Laboratories in France

NONE of the 48 officers and 69 enlisted men operating the water-analysis laboratories in France is on an early list to return home, according to Lieut.-Col. Edward Bartow, senior officer, formerly director of the Illinois State Water Survey. It is expected that the work in the Service of Supplies will continue for some time in the camps of concentration and embarkation.

Lieutenant Colonel Bartow's first service in France on his arrival, in October, 1917, was under the French Interministerial Commission, by which he was assigned to work in the laboratory of Prof. Louis Lapicque, *Laboratoire Muséum Histoire Naturelle*, on water sterilization by liquid chlorine. Tests made on the raw Seine river water formed the basis of a 30-p. article in the *Revue d'Hygiène* for January-February, 1918. This was reprinted and used by the engineers and sanitary corps officers of the United States Army to explain the process to the officials of French cities in which liquid-chlorine machines had been installed, including Brest, St. Nazaire, Savenay, Tours and Dijon.

Since March most of Lieutenant Colonel Bartow's work has been the organization and supervision of the laboratories of the Service of Supplies and the sanitary control of the water-supplies furnished by the engineers to the armies. Five mobile laboratories have been operating with the armies, and laboratories were established in Paris, St. Nazaire and Tours, France, and in Winchester, England.

Because of the necessity for speed and uniformity in obtaining results, the methods of the American Public Health Association, the American Chemical Society and the United States Treasury Department (Health Service) were adapted to the conditions existing in the American Expeditionary Forces, and were published in bulletin form.

The duties performed by the laboratory staffs included sanitary surveys of occupied areas; bacterial and chemical control of filter plants operated by the United States Army; industrial analyses of waters used in locomotives, laundries and airplane motors, and a comprehensive study of water supplied to troops in transit, leading to a recommendation for the addition of the requisite number of faucets, and facilities for sterilization.

Coal Saved by Electrifying Railroads in Italy

Saving in the use of coal has been effected in Italy in the past few years through the electrification of railroads and the harnessing of the water power of the country to generate electricity. The percentage of railroads electrified in Italy from 1900-1915 is greater than in any other European country. Electric traction of railroads began in Italy in 1900 with installations on the Varesina line, which runs through Milan, Gallarate, Varese and Ponteceresio, and on the Valtellinese line, which runs from Lecco to Chiavenna. Railways which run on mountainous routes and carry heavy trains are the Moncenisio line, the Ceva-Port Savona line, the old line of Giovi and the new supplementary Giovi line. The Moncenisio line is the longest—8.5 miles long, at an altitude of more than 1000 yd. above sea level, continuously on the ascent. The systems installed on these mountain routes increased the carrying capacity and the speed of the railways. There is at present under consideration the electrification of 1250 miles more.

Inland Ship-Steel Fabricating Plants of the Emergency Fleet Corporation

Shops at Pottstown and Leetsdale for Fabricating Hog Island Material, Designed To Produce 10,000 Tons Per Month Each, Are Laid Out for Straight-Line Movement of Material Through Five Aisles

By Leyburn G. Fishach
Authorized Representative, Emergency Fleet Corporation, Leetsdale, Penn.

STRUCTURAL-STEEL shops have fabricated a large tonnage for the shipbuilding program of the Emergency Fleet Corporation. Yet there are certain radical differences, between ship work and bridge or structural work, due principally to the large percentage of bent frames and wide plates characteristic of hull steel. These features affect not only the type and capacity of the equipment, but also the arrangement and spacing of the machines in the shop. Two great ship-steel fabricating plants which have been built for the Emergency Fleet Corporation by the McClintic-Marshall Construction Co. of Pittsburgh, Penn., are therefore strikingly different from bridge shops. They were laid out to suit the classifications of work represented in hull steel and give proper balance of the several departments.

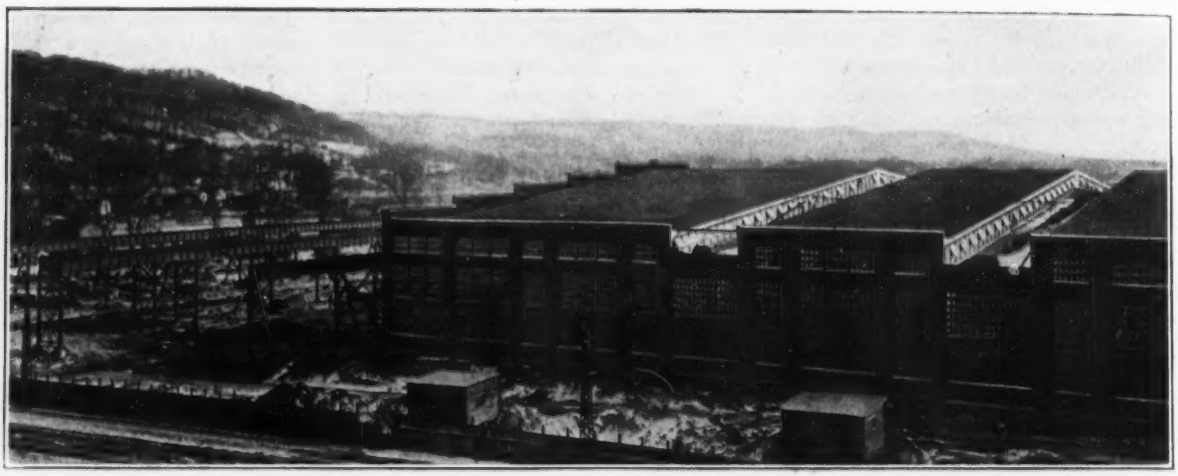


FIG. 1. RECEIVING-YARD END OF LEETSDALE SHOP—AMPLE GLAZING FOR GOOD INTERIOR LIGHTING

One of these plants is at Pottstown, the other at Leetsdale, Penn.; each will have a capacity of 10,000 tons per month when in full operation and will fabricate for the Hog Island Shipyard. They are of the same general design, but in plan are of opposite hand. The following description applies specifically to the Leetsdale shop.

The plant consists of a single shop-building, with receiving yard at one end and shipping yard at the other, all planned for direct straight-line travel of material. The building is 594 ft. long, 390 ft. wide for half the length and 310 ft. for the remainder. It is one story in height, and has steel framing, brick walls, wood sheathing covered with asbestos, and steel sash in both outer walls and roof lights.

The roof construction is of the familiar high-and-low-bay type (see the view, Fig. 1), the bays running across the building. The high bays are 47 ft. wide, the low bays 23 ft.; this alternation of spaces was adopted to reduce the cantilever of the cross-travel cranes. Except for a small area of cement floor at riveter runs and clay floor in the forge shop, the floor is made of $1\frac{3}{8}$ x 6-in. maple laid on 4 x 6-in. chestnut sleepers over a 4-in. concrete foundation. All the exposed steelwork and brickwork on the interior of the building, down to within 8 ft. of the floor, is painted white, to improve the interior lighting, as is also the under side of the roof sheathing.

Continuous forward movement of ship steel will begin in the receiving yard and terminate in the shipping yard, at opposite ends of the building. These yards are 510 x 210 ft. each, placed at right angles to the building. They consist of two 80-ft. aisles, formed by runways for five-motor electric traveling cranes of 20 tons capacity, with 28-ft. height of lift; each aisle has one crane. Adjoining the receiving yard is additional storage area of 70,000 sq.ft., served by locomotive cranes.

Raw material in the receiving yard is stored opposite the shop aisle in which it is to be fabricated. It is thus most easily reached from the narrow-gage tracks which run down the center of each aisle and, as the stock is close to the machines, delays in getting the steel to the operator are minimized.

This latter effect is aided by the arrangement of the outside trackage, which prevents the interruptions to the shop program that would result from unnecessary handling of the raw and finished steel. A double line of tracks extends the full length of the site on each side of the building, and passes under the end spans of the receiving and shipping yard runways. A fifth line crosses the receiving yard and enters the shop. The entire system of trackage within the lot lines has a

total length of 5700 ft. It is connected with a siding 1200 ft. long adjacent to the main line of the Pittsburgh, Fort Wayne & Chicago Railroad.

Shop Division to Suit Fabricating Equipment—The desired arrangement of the fabricating equipment determined the length of spans of the trusses across the building, and divided the floor area into five aisles between the longitudinal column rows. The center aisle is 70 ft. wide, the other four 80 ft. each. These five aisles constitute separate shop units, equipped to act independently in the fabrication of their respective classes of ship steel: Furnaced and forge work, plate and angle work, and beam work. But as the plate and angle work requires more floor area than the other two classes, it occupies the three interior aisles, though there are subdivisions within that area for convenience in handling the steel. This unit system prevents backward motion of material and reduces cross travel into other aisles, so that it is a determining element of economical operation.

Transverse Crane System—The crane system within the building is contrary to the usual practice in that all cranes operate across the shop or aisle, while forward motion through the entire length of the building is by means of steel-framed trucks on an industrial track in the center of each aisle. One cross-line with turntables at each main line makes all parts of the shop accessible by the track system.

Traveling-crane rails are framed below the roof trusses at a spacing to give crane spans of 23 ft., and intermediate spaces 12 ft. wide. The run of cranes in the first and fifth aisles is confined to those aisles, while the three aisles forming the plate-and-angle shop have runs continuous across all three, corresponding to the unity of work in these aisles. Sixty of the 23-ft. cranes are installed, 52 being of six tons capacity and eight of 10 tons. All are operated electrically and are controlled from the floor. They furnish a complete handling equipment for each machine or small group, as the case requires, thus preventing the delays that are likely to occur when cranes traveling longitudinally serve a number of operators.

At the receiving-yard end of the building are two 5-ton electric traveling cranes with a span of 43 ft., operating on a runway extending entirely across the shop, by means of which it is possible to transfer material crosswise without using floor trucks on the cross-track near the center of the building. As shearing and most of the detail work are performed before other fabrication, these two cranes distribute the steel to the different aisles after this preliminary work is completed.

Furnace and Forge Aisle—Designed for the fabrication of all furnaced and smith work, the first aisle has three channel and angle furnaces for material 40 ft. long and one for shapes 50 ft. long, all built out into the receiving yard. These furnaces are inclosed within brick walls and are protected by reinforced-concrete roof slabs.

Some of their auxiliary mechanical features, of very unusual type, accomplish marked saving in labor. The shapes to be bent enter the furnaces from the receiving-yard end over a roller table and are moved forward by a motor-driven frame. When the steel is heated, it is

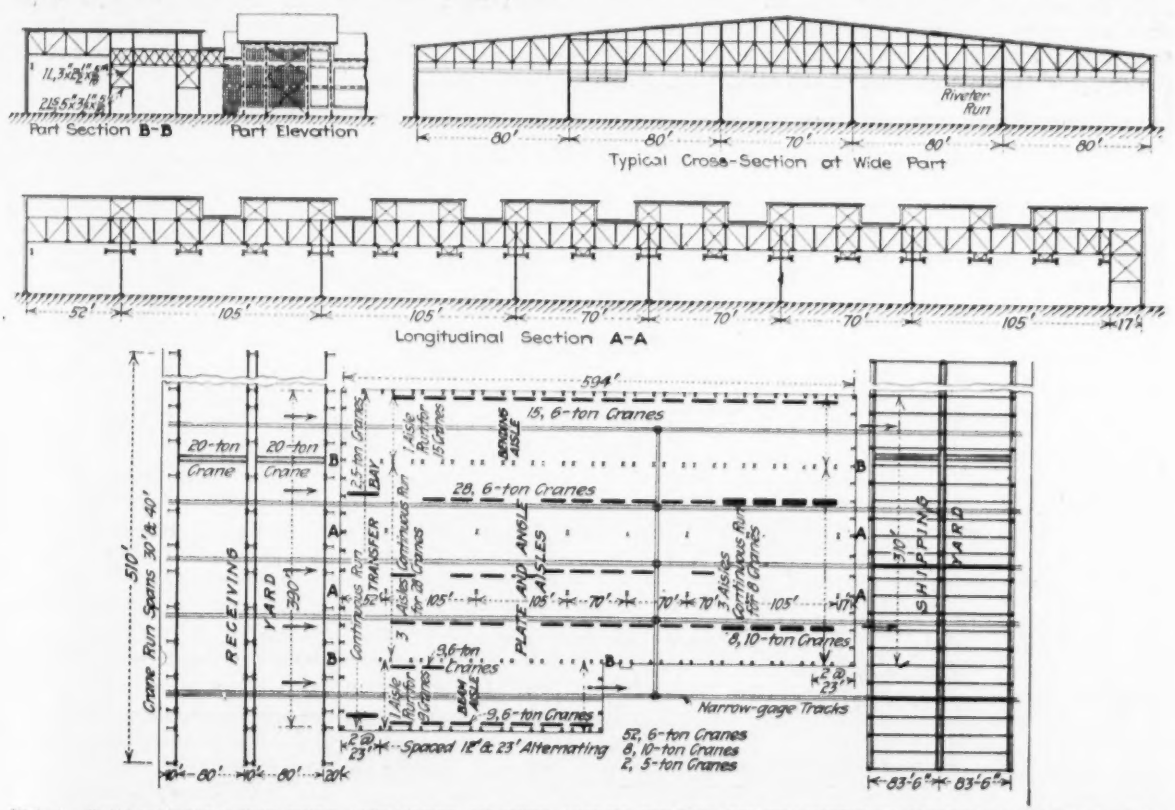


FIG. 2. SHIP-FABRICATING SHOP ARRANGED IN FIVE AISLES SERVED BY TRANSVERSE OVERHEAD CRANES AND LONGITUDINAL TRACKS; RECEIVING YARD AT LEFT, SHIPPING YARD AT RIGHT

pushed out of the other end of the furnace by the same power and then through a flaring or beveling machine, which, in the case of channels, flares both flanges at the same time. The shape is then on the bending floor and is pulled by electric winches around pins in the floor set to templet. This is all done in one heat.

The bending-slab area of the two sets of furnaces is 4200 sq.ft. One motor-driven beveling machine is provided for each pair of furnaces, each being mounted on a truck running on a narrow-gage track parallel to the front line of the furnaces, so that the machines can readily be placed in position where needed. Of the two machines, one is designed for angles and the other for channels.

The forge shop, following next after the bending floor, contains 12 forges and five blocks, for bending small angles and similar parts. There are also knuckling forges, hammers and a flanging press with furnaces adjacent, and a bulldozer and a gag press. Beyond these machines all material is worked cold. Layout skids are followed by four punches, two horizontal and two vertical.

At this point the cross-track enters the aisle. A 700-ton keel bender is located here for convenience; its base is set in a reinforced-concrete pit. An electric hoist on an overhead runway is provided for handling the steel fabricated by this machine.

Assembling Division—The remaining portion of the furnace and forge aisle forms the fitting and assembling shop. Two riveter runs with rivet-heating furnaces adjacent are required for the built-up sections; they are installed opposite each other along the sides of the aisle, in order to centralize the work. A second hydraulic gag-press, which is a duplicate of that near the forges, and two radial countersinking arms, complete the equipment. This division of the aisle, then, forms an independent shop for certain classifications of ship steel.

Fabricated material leaving the aisle is finally advanced by truck over a track scale at the entrance to the shipping yard and is ready for shipment.

All the hydraulic machines in the plant, except one, are located in the bending aisle. Tables are provided for the countersinking arms only. All other equipment is served by two-ton jib cranes with electric hoists. Similar hoists are provided for the riveter runs.

Plate-and-Angle Section—The second, third and fourth aisles may be considered the plate-and-angle shop, though it is subdivided into several separate units. In the second aisle narrow rectangular plates, sketch plates and angles (except the largest sizes) are fabricated. Further, this aisle, in conjunction with the first, builds the floors of the ship, as they consist of narrow vertical plates, angle frames and intercostals. This is all punched and riveted work which can be carried along uniformly and assembled without transfer to other parts of the shop.

For plate punching, one 12-in., three 48-in., and four 72-in. punches are provided in the second aisle, those with 48-in. throat being equipped with roller tables, and the large punches with tables manually operated in two directions. Two 48-in. plate shears, with roller tables, and a rotary shear were installed near the 72-in. punches for convenience in fabricating sketch plates and similar work. Opposite one of the 48-in. punches is a joggling press of 350 tons capacity, provided with electric hoist and runway, and designed also to cut manholes up to 18 x 30 in. at one stroke. These openings were formerly cut by flame in most shops, and this part of the floor fabrication was therefore performed with unnecessary delay and difficulty, on account of lack of better facilities.

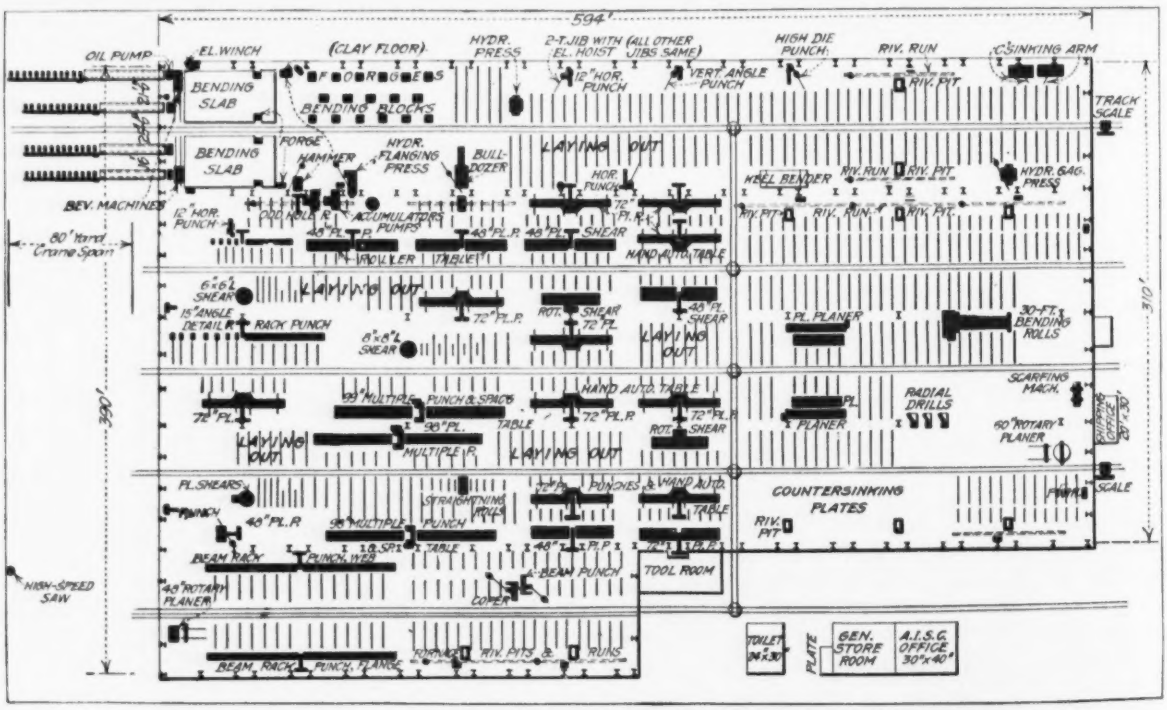


FIG. 3. ARRANGEMENT OF MACHINES; MATERIAL MOVES FROM LEFT TO RIGHT IN FABRICATING SHOP

FIG. 4. BENDING AISLE OF POTTSTOWN SHOP IN DECEMBER, 1918, WHILE MACHINERY WAS BEING INSTALLED

The angle shop is not a separate division within the aisle, but the equipment is located at the beginning of the aisle for convenience. It consists of an angle shear on a rotary base, a two-angle rack punch with a spacing table, an odd-hole punch, and a 15-in. detail punch. The remainder of the aisle, which represents two-fifths of its area, is arranged for assembling the parts, and three riveter runs are provided for the purpose.

Multiple Punches for Large Plates—All large plate work, such as shell and deck plating, bulkheads and tank tops, and also large angles, will be fabricated in the third and fourth aisles. Since this plate work involves only planing, punching and countersinking, a large tonnage will be obtained from the three 98-in. multiple punches located near the receiving-yard end of the shop. These machines will punch 40 holes $\frac{15}{16}$ in. in diameter through $\frac{3}{4}$-in. metal and shear a plate 84 x $\frac{3}{4}$ in., all at one stroke. Two of the punches are equipped with end shears and side-trimming knives. Roller tables of original design are provided.

For plates which cannot be entirely punched in the multiples, and for other single punching, six 72-in. punches with manually operated tables, and one 48-in. punch with a roller table, follow the large machines. Irregular and curved cuts are made by a rotary shear after the plates are laid out. The detail work is done at the beginning of the aisle by a 25-in. and a heavy 48-in. punch. Special shearing is also done at this point, the plates being deposited over an inclined table. For straightening plates, a set of six rolls has been installed near the punches, with capacity to correct 1-in. plates at a speed of 35 ft. per minute.

After punching is completed, the plates are laid out and are advanced to the planers, located in the third aisle. Two of these machines are required to balance the plate capacity of the punches. They will plane the edges of plates 1 to $1\frac{1}{2}$ in. in thickness to a length of 30 ft. at one setting; the plates are clamped by a series of pneumatic jacks.

Molded plates will be passed through a set of 30-ft. bending rolls adjacent to the planers. A row of three radial drills for holes that cannot be punched, and also floor space for operating portable buggies carrying motor-driven countersinking drills, are provided near the end of the third aisle. Ten of these buggies, each operated by one man, are required for the plate shop.

Before passing over the scales, the plates from the third and fourth aisles are planed by a 60-in. rotary planer, and are also scarfed, where necessary, on a double-head machine. Three riveter runs at the end of the fourth aisle handle the work requiring shop riveting, which is fabricated on this side of the plate-and-angle shop.

The angle shop in these two aisles was placed at the receiving-yard end, adjacent to the second aisle, where it forms the part of the group handling the heavier

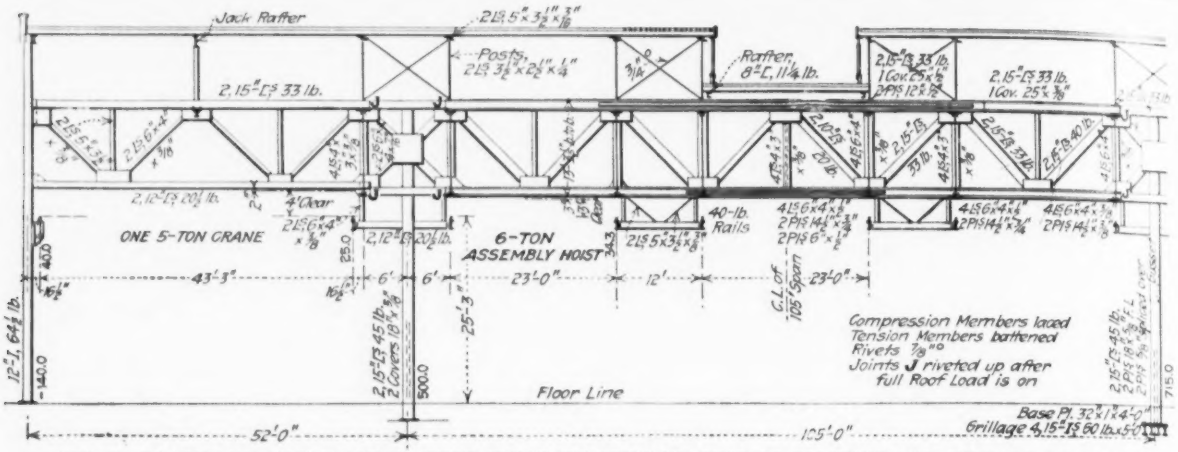


FIG. 5. PLATE-AND-ANGLE AISLES KEPT CLEAR BY WIDE SPACING OF COLUMNS AND SUPPORT OF ROOF BY LONGITUDINAL TRUSSES

material. A 15-in. detail punch, a 4-angle rack punch with a spacing table, and double shears on a turntable for angles up to 8 x 8 x 1¼-in., constitute the equipment.

Beam Shop—The fifth aisle, forming the beam shop, is only 303 ft. long, about half the length of the building. A high-speed friction saw, operated by a 45-hp. motor, is included in this equipment, although located not in the shop itself but just opposite its entrance, in the receiving yard. This saw is designed to cut continuously up to 24-in., 80-lb. beams, and equivalent channels, Z-bars and angles. One 48-in. rotary planer, with tracks and carriage, at the beginning of the aisle, is sufficient to meet the requirements.

On opposite sides of the track, near the entrance, are two beam punches, one for webs and the other for flanges, with die blocks of sufficient height to punch also 8 x 8-in. angles. Spacing tables are provided for these machines. A special beam punch and coping machine follow the punches, with capacity for all standard sections up to 24 in. and for Bethlehem sections up to 30 in. A 24-in. odd-hole beam punch adjacent to the coper completes the equipment in the aisle, except for the riveter runs, of which there are two. No tables are provided for the coper and adjoining punch, as the steel will be handled by jib cranes. This aisle contains the only standard-gage track entering the building; it is laid in conjunction with the industrial track.

Full Equipment of Skids—Throughout the entire building, skids built up of angles and channels form part of the equipment at each machine, wherever their use will facilitate the handling of the steel. Laying-out and assembly skids are 2 ft. high; those for partly fabricated material are 9 in. high; those for certain other machines are of heights required by the special conditions. At the plate-and-angle shears, skids with roller tops are used, and at the riveter runs the skids are movable. In the yards 10 x 10-in. oak skids with steel bar or rail wearing surface are provided.

The offices for the shipping-yard and receiving-yard clerks, and for the superintendent and the inspector, are built as lean-tos, as are also the tool room and electric repair shop. All other auxiliary buildings are detached. The electrical shop contains transformers which step the voltage (2300) down to 220, used for power throughout the shop, except for the cranes, which are operated by direct current of the same voltage. From the second floor of this lean-to a walkway extending through the roof trusses gives access to the cranes for repairs. The main shop is well lighted throughout, with 500-watt lamps in reflectors.

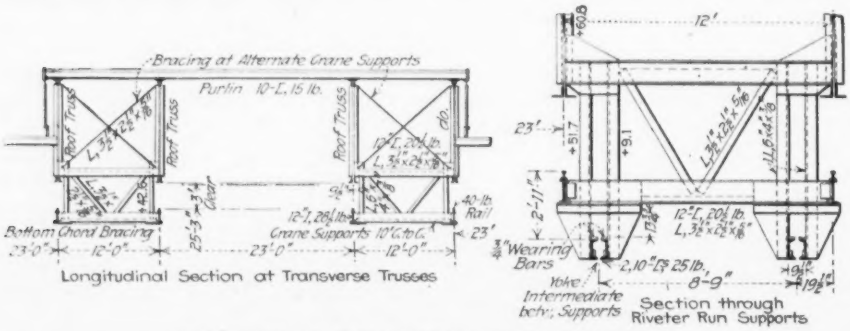


FIG. 6. TYPICAL CRANE-RUN SUPPORT DETAILS

A. McKinley of the McClintic-Marshall Construction Co. designed the Leetsdale and Pottstown plants. The buildings were erected by the Hughes-Foulkrod Co., under the supervision of C. H. Harlan and H. C. Walton, managers of construction at Leetsdale and Pottstown, respectively. J. W. Fenton, assistant authorized representative, was in charge of the work at Pottstown for the Emergency Fleet Corporation.

Head-Office Expense of Highway Department

The division of head-office expense in the New York State Highway Department for the year 1917 is shown in the annual report of H. Eltinge Breed, first deputy commissioner of highways, to be as follows: Checking of final estimates, 23.12 per cent; maps, 13.53 per cent; plans, 13.40 per cent; miscellaneous, 25.22 per cent; lettings, 9.76 per cent; repair work, 7.46 per cent; bulletin, 3.98 per cent; Federal aid, 3.53 per cent.

Preparing Six Hundred Acres of Land for Irrigation

Soil Studies, Surveys, Supply and Drainage Ditches—Land Leveling and Ditch Construction Operations Described—Tractor Plows Run Day and Night—Ground Planes and Scarifiers Used

By F. W. Herron
Daly City, Cal

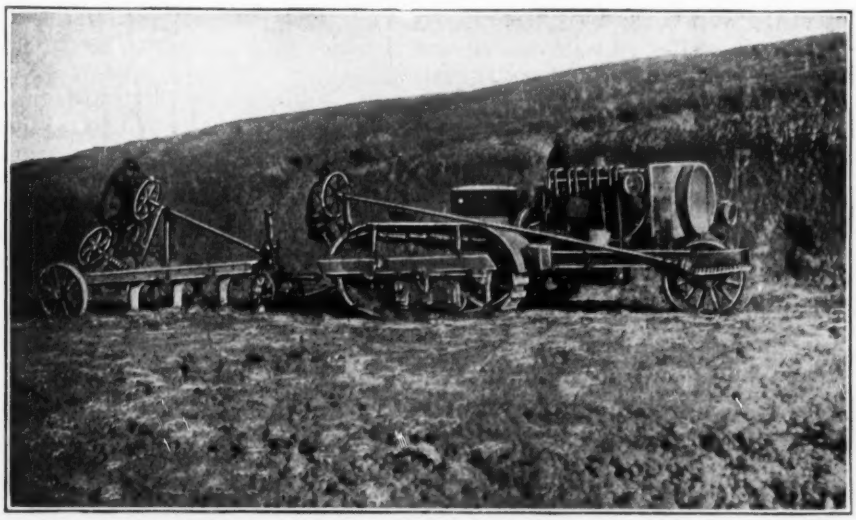
IN PREPARING large tracts of land for irrigation, engineering methods are employed to an increasing extent. Especially is this true when modern farm tractors are used, as the large amount of capital invested in equipment of this kind and the high cost of operation render it essential that the work shall be carefully planned and economically executed. The following account of the preparation of a 600-acre tract with a construction outfit that included 35 scraper teams and five Holt caterpillar tractors describes briefly the engineering features of this kind of work, and gives a summary of costs.

The tract in question is the property of the Crocker-Huffman Land & Water Co., of Merced, in the San Joaquin Valley, California. For some time it has been the policy of this corporation to prepare and seed to alfalfa each year a part of its extensive land holdings included in the Merced irrigation system. The writer was in charge of field work for the company from August, 1915, to July, 1917, and during this two-year period supervised the preparation of about 2500 acres of land, including the tract described in this article. These notes on the work were prepared directly after its completion, but for reasons beyond the control of the writer could not be published then.

The soil on this tract is classed by the Bureau of Soils, United States Department of Agriculture, as Madera clay, and is described as follows: "The Madera clay is a dark brown or reddish brown clay or silty clay varying considerably in texture within short distances. It is compact and very difficult to handle, especially when not worked under proper moisture conditions. When drainage is established, the soil is well adapted to irrigation." In reading this article, and especially considering the cost data, it should be borne in mind that this work was done under very unfavorable moisture conditions, when the ground was too dry and hard to be handled with ordinary horse-drawn farming implements. Before designing the irrigation and drainage system, the writer made a contour map of the tract, to a scale of 400 ft. per inch, and a contour interval of 0.5 ft. Field work was done with transit and stadia. On the finished map a rough paper location was made of all laterals and field ditches and also of all main drainage ditches. Distances and bearings were scaled from the map, and the ditches located in the field with transit and stadia, using compass bearings.

All laterals and field ditches were 8 ft. wide on the bottom, with side slopes of 2:1, a total depth of 4 ft., and with banks 3 ft. wide on top. The usual grade was 1 ft. per 1000 ft. These ditches were so located and constructed that water could be held in them 1 ft. above the highest ground to be irrigated, but in no case was the high-water mark allowed to approach closer than 1 ft. to the top of the ditch bank. Ease of construction and maintenance and an ample water-supply were assured by the adoption of the 8-ft. bottom width for all ditches, while the substantial banks and generous freeboard allowance insured against expensive breakages and seepage losses. Drain ditches were also 8 ft. wide on the bottom, and about 2 ft. deep, and were located as far as possible on natural drainage lines. They were intended, of course, to provide surface drainage only.

As the ground surface was rough and broken, with numerous large knolls and depressions, it was necessary in laying out the tract to adopt the method known as contour checking. In this method low levees are built on contour lines, and the areas between levees are irrigated by flooding. The contour interval used in this case varied from 5 to 0.3 ft., the latter being employed wherever possible. The check levees were 6 ft. wide on the bottom, and from 12 to 16 in. high. Levee lines were located on the ground by a level party, which set stakes from 50 to 100 ft. apart, marking them with the contour elevation. In order to render these stakes plainly visible, the writer adopted the cheap and very



SCARIFIERS DRAWN BY 30-HORSEPOWER TRACTORS LOOSEN DIRT FOR DITCHES AND CUT DOWN KNOLLS

TABLE I. COST OF PREPARING 600-ACRE TRACT FOR IRRIGATION

	Per Acre	
Engineering and Superintendence:		
Surveying	$1 37	
Superintendence and overhead	1 90	$3 27
Team work:		
Irrigation ditches	10 73	
Drainage ditches	5 68	
Checking and leveling	5 19	21 60
Tractors:		
Plowing	3 15	
Leveling	7 96	
Scarifying for ditches	2 62	
Scarifying finished checks	2 71	
Scarifying for leveling	25	
Building levees and small drains	1 45	
Harrowing finished checks	21	18 35
Structures:		
Canal structures	4 20	
Service structures	11 61	15 81
Total cost per acre		$59 03

Total length of irrigation ditches, 33,200 ft. Total yardage moved, 44,513 cu.yd., or 1.34 cu.yd. per linear foot of ditch. Cost per cubic yard, $0.172.

effective expedient of dipping the tops in whitewash. Great care was taken in locating the levees to avoid all sharp bends and loops and to make the total amount of earthwork a minimum, at the same time securing a check that could be irrigated quickly and evenly. After the lines were located they were marked by a single plow furrow, and the levees were constructed by a small gang of scraper men with special experience in that kind of work.

In starting construction work, a block containing about 100 acres was laid off at one end of the tract and plowed by the tractors. One 75- and two 60-hp. tractors were employed on the plowing, each drawing two six-gang disk plows. The ground was so hard that the plows were frequently broken, and in the case of the 60-hp. tractors it proved necessary to remove two disks from each rear gang. As soon as this block was plowed, work was started on another, about the same size, and immediately adjacent to the first, plowing with night shifts only. Day crews were started on the first block rough leveling with ground planes. Ditches were also staked out on this block, and construction work was started on them with teams and fresnos. As soon as the ground was approximately level and the ditches were completed, the levees were staked out and built, and the ground inside the checks was finally leveled by the ground planes. Work proceeded in this way from one end of the tract to the other, the different gangs being so proportioned that all main ditches were built well in advance of the levee building and finish leveling.

As soon as the checks were completed, stakes were set to mark the location of all water gates and boxes and a gang of men was put to work making the excavations for them. Double-wing wooden gates, with a 6-ft. opening, were placed in the canal banks at all points at which water was to be diverted to the checks, and also in the levees wherever water was to be turned from one check to the other. Smaller single-wing boxes were placed in the levees at points where the water from a check was discharged into a drainage ditch. All these service structures were built at the ranch headquarters, three miles away, and hauled to the work by a three-ton motor truck, which distributed them in convenient piles along the road bordering the tract. From these piles the gates were loaded on wagons and hauled to their places in the field. Over 200,000 ft. bm. of cedar lumber, costing about $30 per 1000 in place, was used in making these gates and boxes.

Some special implements used on this work were the ground planes and the scarifier shown by the two views. These ground planes were invented by Henry A. Lage, general superintendent of the Crocker-Huffman Co., and were built on the ranch under his direction. They are easily handled, move dirt at a low cost, and very thoroughly pulverize the most refractory soil during the process of leveling. A 12-ft. plane, drawn by a 60-hp. tractor, will average about 2 yd. of dirt at a load, and in ordinary leveling will handle from 200 to 300 yd. per day. The depth of the cut or fill is easily regulated, and excellent leveling can be done by the ordinary unskilled laborer, after a few days' practice.

The scarifier was used in loosening dirt in the ditches and in cutting down some of the large knolls, as the very hard soil could not be plowed successfully by the teams. This scarifier was drawn by a 30-hp. tractor and loosened about 1000 cu.yd. of dirt per day, breaking it up so that it was easily handled by the fresnos. In the illustration the scarifier is shown breaking up hardpan in a large canal constructed in another part of the county.

Itemized costs of the work are given in Table I. Table II shows the daily cost of operation of a 60-hp. tractor and Table III is a performance record of a 45-hp. tractor which was used in plowing, harrowing, and scarifying in the finished checks, to prepare them for seeding. These performance records were kept for each machine and served a double purpose. Not only did they reveal errors in operation and deficiencies in equipment but they also fostered a healthy spirit of rivalry, between individual tractor drivers, that resulted in decidedly increasing the amount of work performed per tractor per day. All data shown in these tables were abstracted from the complete records kept by the company, and are accurate and reliable.

In the past the irrigation engineer has considered his

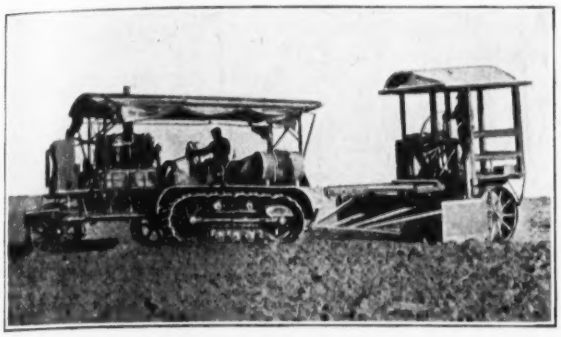
TABLE II. DETAILED COSTS OF OPERATING 60-HORSEPOWER TRACTOR NO. 2008

Item	Cost per Day
Interest and depreciation	$4 56
Wages of tractor crew	4 80
Board of tractor crew	1 68
Teams	50
Distillate, 36 gal	2 17
Engine lubrication, 2.5 gal	.78
Track lubrication (crude oil), 13.5 gal	42
Cup grease, 2.5 lb	13
Repairs	4 08
Miscellaneous labor	2 43
Miscellaneous supplies	78
Implements (repairs, interest and depreciation)	2 71
Superintendence and general overhead	2 67
Total daily cost	$27 71
Total daily cost:	
Tractor No. 2116, 75 hp	30 20
Tractor No. 2003, 60 hp	25 70
Tractor No. 20080, 45 hp	17 25

TABLE III. PERFORMANCE RECORD OF 45-HORSEPOWER TRACTOR NO. 20080

Item	Hours	Minutes	Per Cent of Total Time
Starting delay	20	50	4 84
Engine trouble	8	20	1 94
Repairing track	5	30	1 28
Repairing cooling system	12	45	2 96
Repairing implements	5	35	1 29
Filling and greasing	23	00	5 35
Traveling to and from service station	18	45	4 36
Rain	8	00	1 86
Lost time	102	45	23 88
Working time	327	15	76 12
Total time, 43—10-hr. days	430	00	100 00

work completed when he has brought the water to the outskirts of the irrigable land. The equally important and rather more difficult task of preparation for the efficient and economical application of the water to the soil has been left largely to the farmer. The partial or complete failure of most of our irrigation projects will testify to the fact that this method of procedure



GROUND PLANES DRAWN BY 60-HORSEPOWER TRACTORS LEVEL LAND AND PULVERIZE SOIL FOR IRRIGATION

has not been an unqualified success. Since increased crop production has become and will doubtless remain a matter of great national importance, the writer believes that the engineering profession can well afford to devote some of its attention to the problem of the economical preparation of land for irrigation.

American Engineer at Burma Camp Fights Epidemics

Detention Camp on Railroad Effective, but Coolies Bring in Cholera Through Jungle—No Uncooked Food Permitted

By Harry N. Jenks

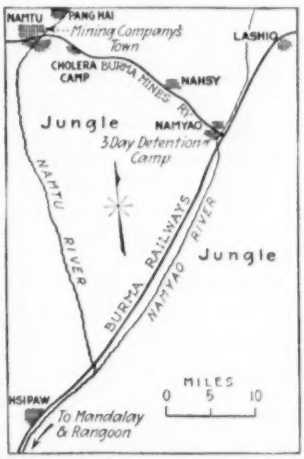
Sanitary Engineer, Burma Mines, Limited, Namtu, Burma

Combatting three highly contagious deadly diseases within six months, two of them simultaneously, in the experience of the author of this article, a young sanitary engineer of Berkeley, Cal., who has been with a British mining company at Namtu, Burma, India, for the past two years. As an instance of where and into what the coming international trade will carry pioneering American engineers, these notes and also Mr. Jenks' longer article on sanitation at the Namtu mining camp, printed in "Engineering News-Record" of Jan. 23, p. 172, are timely and informing.—Editor.

THINGS may happen slowly in Burma, but when they do happen they take a long time to stop. For the first time in the camp's history, we had bubonic plague last spring; and it is only now (Oct. 18, 1918) that we are nearing the end of a four months' fight against cholera, a fight that was made all the more difficult by the simultaneous occurrence of a severe epidemic of influenza. From the standpoint of training in public health work, this year has furnished me with exceptionally good experience, but the number of coolies that have been claimed by the epidemics, and those that have disappeared into the jungle to escape infection, have left us with barely enough labor to "carry on."

This has been a particularly untoward year all over India, as regards the prevalence of sickness. Unseasonable weather created conditions that seemed to favor the spread of both influenza and cholera. Earlier in the year the unusual conditions of temperature and moisture were, presumably, largely responsible for the appearance of plague, which in the first instance came probably from some previously infected place, such as Mandalay. Neither the plague nor the cholera was in true epidemic form, occurring as each disease did in sporadic cases, mainly with no apparent causal connection. If, however, there ever was an epidemic anywhere, the influenza that struck us takes highest honors. It started about last June in Bombay, traveled all over India, came up through Burma from Rangoon, and carried away with terminal pneumonia some 200 known cases among the natives in Namtu.

Our cholera troubles started last June, when the disease broke out in Hsipaw and spread through the jungle, paralleling the Burma Rys., as far as Lashio. The sketch shows the position of these towns in relation to Namtu and the company's railway that connects with the Burma Rys. at Namyao. Precautionary measures were taken immediately to prevent the infection from traveling up our line to Namtu. We established a detention camp at Namyao, where all third-class passengers from the Hsipaw side as far as Maymyo were kept under observation for three days before being allowed to proceed on our railway. All foodstuffs from infected areas were destroyed. No food that could be eaten uncooked was permitted to be kept for sale in the local bazaars. Guards were placed on roads and trails through the jungle to intercept all persons going from infected areas toward Namtu.



THREE-DAY DETENTION CAMP AT NAMYAO KEPT CHOLERA FROM NAMTU FIVE WEEKS

In this and other ways we kept the infection at a distance for about five weeks, when a case suddenly developed in Namtu, and within a few days sporadic cases were reported all along the line to Namyao. Pretty nearly everybody was then taken off his regular job and detailed to help the medical and sanitary staff to cope with the situation. In this work we received the assistance of Government medical officers, who spotted cases and administered treatment. We built a big cholera camp at Hsaikhao to receive contacts and to care for the cases that developed among them, and for such cases as could be sent to the camp.

In Namtu we placed a European guard, working in eight-hour shifts, over our water-supplies. We discontinued the fresh milk supply, and for a while subsisted mainly on potatoes and onions for vegetables. A cordon of men was flung around the European side of the camp, and a guard was stationed at the bridge across the Namtu, in order to prevent any coolies from

the jungle coming into camp. This step was necessary because of the fact that the coolies had the dangerous habit of straggling along the open road or through the jungle from village to village when in the initial vomiting and purging stage of the attack.

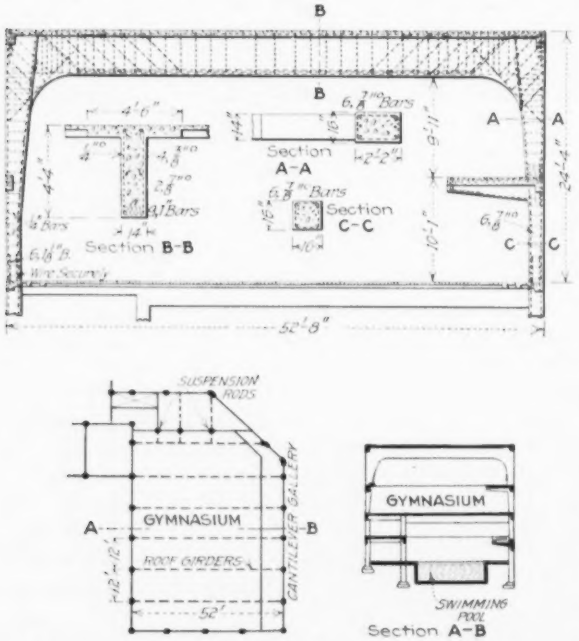
Within a short time Namtu itself was freed from infection, but up to Oct. 18 residual cholera has persisted in the jungle stations and villages. About four weeks ago I was detailed to take charge of the anti-cholera work along the railway, with headquarters at Nahsy, in order to attack the last footholds of the infection. After three weeks' work, the chief features of which were the continual inspection of all dwellings, the spotting of cases of sickness and provision for their treatment, and the disposal by incineration of those cases that terminated fatally, we have apparently attained our object; although even after the required 21 days' time has elapsed since the last case one cannot be certain that a sporadic case may not appear suddenly.

Long Girders and High Columns Designed as Rigid Frame

Gymnasium Requiring 52-Foot Span and 20-Foot Clearance in Height Carried as Third Story of Building

By A. E. Wynn
Truscon Steel Co., Syracuse, N. Y.

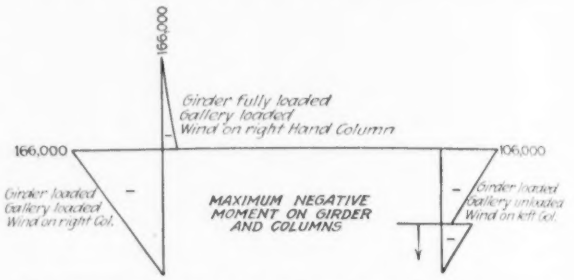
Architectural requirements in the layout of the Y. W. C. A. building, at Syracuse, N. Y., necessitated the use of some rather unusual details in the design of the reinforced concrete which was used



ROOF OVER GYMNASIUM OF REINFORCED CONCRETE, DESIGNED AS RIGID FRAME

throughout the building. In the gymnasium, a wing of the main building, a rigid frame analysis was followed for the 52-ft. roof beams and attached columns.

The lower portion of this section of the building is excavated for a swimming pool 60 ft. by 25 ft. in plan and sloping in depth from 4 to 8 ft. The sides are 10-in. concrete walls reinforced for both earth and water pressure. Above the tank, and on all sides, is a gallery. Along two sides this consists of a slab, varying from 4 to 7½ in., thick cantilevered out 7 ft. from the wall lintels, and on the other two sides it is carried on beams and columns. Above the swimming pool is the gymnasium floor. This is carried over the pool by beams of 38 ft. span, 14 in. wide and 30 in. deep,



MAXIMUM NEGATIVE MOMENTS FOR EACH COLUMN AND GIRDER

Showing the column not carrying the gallery is under larger bending moment

with a floor slab of 4-in. terra cotta tile and 2-in. concrete.

The gymnasium itself had to be free of columns, so in order to frame the roof it was necessary to span 52 ft. from wall to wall at a height of 24 ft. above the floor. Long girders of this type are usually designed as simple beams freely supported at the ends, and the columns simply to take the total loads and then increase to a section conforming to some empirical rule, such as making the depth a certain fraction of the span and adding so much steel to the outside face. This method generally gives sections which are too large, and there is usually doubt as to what stresses exist in the columns. In this particular case the structure was designed as a rigid frame, the girder being considered monolithic with the columns. As it was to be used for sport, the roof slab was designed for a live-load of 100 lb. per square foot, and the columns and girders for 60 lb. per square foot. Maximum fiber stress in the girder was 650 lb. and in the column 700 lb. per square inch.

The design of the frames is shown in the accompanying detailed drawings. The columns are 12 ft. apart and in section are 16 in. wide and 26 in. deep at the top, and 16 in. wide by 16 in. deep at the bottom. They are reinforced symmetrically, the columns carrying the gallery with six ¾-in. square bars, and the opposite ones with six 1¼-in. square bars. The girders are 14 in. wide by 52 in. deep, the roof slab forming a T 54 in. wide, and they are reinforced with nine 1-in. and two ¾-in. square bars. Some of the outside bars in the columns are bent over into the top of the girder, and some of the bars in the girder are bent well down into the columns, thoroughly bonding the girder and columns. At the junction of the columns and girder are curved brackets, which add greatly to the appearance of the structure and provide greater depth to the columns and girder at points of maximum negative moment.

The method used in designing these frames was as follows:

Any load acting upon the frame will cause the girder to take a certain slope at its junction with the columns. This slope can be calculated for any condition of loading and is dependent not only upon the loading but upon the relative stiffness of the girder and columns and the amount of fixation at the base of the columns. Knowing the angle of slope, the moment at the junction of column and girder required to produce this slope can be found. By equating the moments of the external forces on one side to this moment, the thrust at the base of the column is obtained. The moment at any point in the frame can then be easily found, and then the stresses.

Taking the simplest case of the girder uniformly loaded and using the following symbols:

l = span of girder columns c. to c.;
h = height of columns;
w = uniform load per foot;
L = slope of girder at junction to column;
E = modulus of elasticity;
I_B = moment of inertia of girder;
I_C = moment of inertia of column;

then

I_B/l is a measure of stiffness of girder

and

I_c/h is a measure of stiffness of column.

K = constant depending on amount of fixation at base of column = 3 if base is considered free.

Then for a beam uniformly loaded and considered as monolithic with the columns the slope L is given by

$$L = -\frac{wl^2}{12}\left(\frac{1}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)\frac{1}{E}$$

and the moment required to produce this slope is given by

$$M = K\frac{I_c}{h}EL$$

$$M = \frac{3I_c}{h}\left(-\frac{wl^2}{12}\times\frac{1}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)$$

$$= -\frac{wl^2}{12}\left(\frac{\frac{3I_c}{h}}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)$$

and if H = horizontal thrust, $H = M/h$. In a similar manner the thrust for other conditions of loading are found.

The different steps in design are as follows:

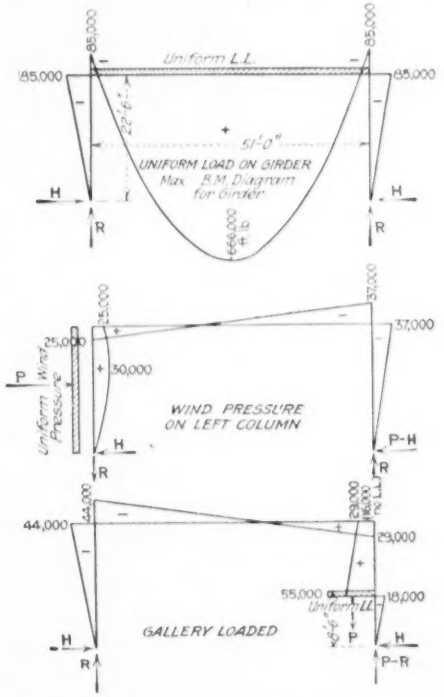
1. Design the girder with full live load for a bending moment of $wl^2/12$ at the center and $wl^2/24$ at the supports to obtain the approximate size, area of steel and width of T. Assume a column section, placing the steel symmetrically.

2. Calculate the moments of inertia of the girder and column.

3. Take the different conditions of loading, such as girder loaded and unloaded, gallery loaded and unloaded, and wind pressure on either side, and for each condition calculate the horizontal thrust H and vertical reaction R at the base of the columns, assuming that they are free at these points, as this condition gives the maximum moments in the columns.

4. Knowing these thrusts and reactions, the bending moment at any point in the frame can be found by taking moments about that point. Draw the moment diagram for each force acting upon the frame.

5. It will be seen from these, as shown in the accompanying diagrams drawn, for this particular case, which combination of loadings will give the maximum positive



BENDING MOMENT DIAGRAMS SHOWING BENDING ACTION OF LOADS ON GIRDERS FOR THREE DIFFERENT CONDITIONS OF LOADING

and negative moment in the girder and columns. Draw a final moment diagram giving these worst conditions combined.

6. Check the maximum moments found for the girder with those originally assumed.

7. Combine the maximum moment in the columns with the corresponding vertical reactions, and hence find the fiber stress for a column under bending and axial thrust.

8. If the moments in the girder differ materially from those assumed, and if the stress in the columns is higher or much lower than the allowable stress, it will be necessary to change the sections or steel areas or both, and as this will change the respective moments of inertia, the calculations will have to be repeated. Experience tells the sections to assume, and it is not often necessary to make more than two sets of calculations.

9. The outward thrust at the base of the columns must be taken care of by tie rods or if, as in this case, they are connected by beams, by the tension steel in the beams. It is not really necessary to draw the bending-moment diagrams, as an examination of the direction and magnitude of the thrusts will show which

are the worst conditions. Even if, as in this case, the columns are continuations of columns carrying the floors below, they cannot be considered as fixed at their base, but if any doubt exists as to the amount of fixation the calculations can be repeated for a frame with fixed ends and the stresses found at the foot of the columns. A much higher fiber stress can be assumed as safe, as absolute fixation hardly ever occurs.

Referring to the accompanying moment diagrams, it will be seen that the maximum positive moment occurs in the girder when the roof is fully loaded, the gallery is unloaded and there is no wind pressure. The column not carrying the gallery has maximum moment when the girder and gallery are fully loaded and with wind pressure on the opposite column. These conditions also give the maximum negative moment in the girder. The worst condition for the column carrying the gallery is when the girder is loaded, the gallery is unloaded and there is wind pressure on the opposite column. The roof load brings tension on the outside face of the columns and is a maximum at the top. Wind pressure brings tension upon the inside face of the column it is acting upon and upon the outside face of the opposite column, thus decreasing and increasing, respectively, the tension at the top of the columns.

When the gallery is loaded it brings tension on the inside face of the column above the gallery and on the outside face of the opposite column, having an effect similar to that of wind pressure.

The maximum fiber stress in the girder was 650 lb. per square inch and in the columns for worst conditions 700 lb. per square inch. The architects for the building were Taylor and Bonta, of Syracuse and the general contractors were Dawson Bros., of Syracuse.

Mechanical Devices Help Overcome Engineer Shortage

Combined with Tables and Standard Formulas, They Work Out Well in South Carolina Highway Department

By R. A. Brown

Assistant Engineer, South Carolina State Highway Department, Columbia, S. C.

With so many draftsmen and computers called into military service, it was a problem to utilize the less experienced men and get out presentable plans in a reasonable length of time. The State Highway Department of South Carolina lost 27 men to military service during the past 15 months. To utilize new recruits and some of the field men on plans and computations mechanical devices have been adopted, as it is easier for the average boy under 18 years of age to learn the use of a mechanical device than to perform intricate or even fairly easy computations.

A calculating machine is used by the department for most of the larger computations. Much of this work is done by a young woman who had no previous experience in engineering computations. To aid her in computing grades on vertical curves, the formula and a typical example worked out in detail were written out and pasted alongside the keyboard. The formula used is that for the approximate parabola: Middle ordinate, $M = \frac{1}{8}(G_2 - G_1)L$, where G_1 is the grade of the back tangent with proper sign, G_2 is the grade of the forward tangent with proper sign and L is the length of curve in stations. A plus result indicates that the ordinate is to be added to the elevation on tangent.

To enable the computers to find from the middle ordinate the ordinates at other points on the curve, the table herewith was computed for the curves usually used by this department. Having the middle ordinate, multiply it by the factor opposite the given distance and under the length of curve being used, to get the ordinate at any given distance from either end of the curve.

Since the grades can be added, the result multiplied

VERTICAL CURVE TABLES

Factors by which the middle ordinate must be multiplied to obtain ordinate at a given distance from point of curve. Example: On a 200-ft. curve, the ordinate at a distance of 27 ft. is 0.073 × middle ordinate.

Dist. Along Curve	200-Ft. Curve Factor	250-Ft. Curve Factor	300-Ft. Curve Factor	Dist. Along Curve	200-Ft. Curve Factor	250-Ft. Curve Factor	300-Ft Curve Factor
1	0 0001	0 00006	0 00004	51	0 260	0 166	0 116
2	0 0004	0 00027	0 00018	52	0 270	0 173	0 120
3	0 0009	0 00058	0 00040				
				53	0 281	0 180	0 125
4	0 0016	0 0010	0 0007	54	0 292	0 187	0 130
5	0 0025	0 0016	0 0011	55	0 303	0 194	0 135
6	0 0036	0 0023	0 0016				
				56	0 314	0 201	0 140
7	0 0049	0 0031	0 0022	57	0 325	0 208	0 144
8	0 0064	0 0041	0 0028	58	0 336	0 215	0 149
9	0 0081	0 0052	0 0036				
				59	0 348	0 223	0 155
10	0 010	0 006	0 004	60	0 360	0 230	0 160
11	0 012	0 008	0 005	61	0 372	0 238	0 165
12	0 014	0 009	0 006				
				62	0 384	0 246	0 171
13	0 017	0 011	0 008	63	0 397	0 254	0 176
14	0 020	0 013	0 009	64	0 410	0 262	0 182
15	0 023	0 015	0 010				
				65	0 423	0 271	0 188
16	0 026	0 017	0 012	66	0 436	0 279	0 194
17	0 029	0 019	0 013	67	0 449	0 287	0 200
18	0 032	0 021	0 014				
				68	0 462	0 296	0 205
19	0 036	0 023	0 016	69	0 476	0 305	0 212
20	0 040	0 026	0 018	70	0 490	0 314	0 218
21	0 044	0 028	0 020				
				71	0 504	0 323	0 224
22	0 048	0 031	0 021	72	0 518	0 332	0 230
23	0 053	0 034	0 024	73	0 533	0 341	0 237
24	0 058	0 037	0 026				
				74	0 548	0 351	0 244
25	0 063	0 040	0 028	75	0 563	0 360	0 250
26	0 068	0 044	0 030	76	0 578	0 370	0 257
27	0 073	0 047	0 032				
				77	0 593	0 380	0 264
28	0 078	0 050	0 035	78	0 608	0 389	0 270
29	0 084	0 054	0 037	79	0 624	0 399	0 277
30	0 090	0 058	0 040				
				80	0 640	0 410	0 284
31	0 096	0 061	0 043	81	0 656	0 420	0 292
32	0 102	0 065	0 045	82	0 672	0 430	0 299
33	0 109	0 070	0 048				
				83	0 689	0 441	0 306
34	0 116	0 074	0 052	84	0 706	0 452	0 314
35	0 123	0 079	0 055	85	0 723	0 463	0 321
36	0 130	0 083	0 058				
				86	0 740	0 474	0 329
37	0 137	0 088	0 061	87	0 757	0 484	0 336
38	0 144	0 092	0 064	88	0 774	0 495	0 344
39	0 152	0 097	0 068				
				89	0 792	0 507	0 352
40	0 160	0 102	0 071	90	0 810	0 518	0 360
41	0 168	0 108	0 075	91	0 828	0 530	0 368
42	0 176	0 113	0 078				
				92	0 846	0 541	0 376
43	0 185	0 118	0 082	93	0 865	0 554	0 384
44	0 194	0 124	0 086	94	0 884	0 566	0 393
45	0 203	0 130	0 090				
				95	0 903	0 578	0 401
46	0 212	0 136	0 094	96	0 922	0 590	0 410
47	0 221	0 141	0 098	97	0 941	0 602	0 418
48	0 230	0 147	0 102				
				98	0 960	0 614	0 427
49	0 240	0 154	0 107	99	0 980	0 627	0 436
50	0 250	0 160	0 111	100	1 000	0 640	0 444

by the length of curve, divided by 8, and the quotient multiplied by the factor taken from the table without clearing the calculating machine, the operation of figuring ordinates is accomplished very quickly. To find ordinates for 400-, 500- and 600-ft. curves, take one-fourth the ordinates given under 200-, 250- and 300-ft. curves, respectively, for the same distance.

It might be added that the calculating machine is used also for finding elevations of grade on tangents, as well as on vertical curves. Starting from a given elevation on the grade tangent, the rate of grade is added or subtracted successively for each 100-ft. station. For fractional stations the rate is quickly multiplied on the machine by the fractional station, and applied.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Properly Allocating the Cost of Highway Transportation

Sir—The letter by W. Earl Weller, city engineer of Binghamton, N. Y., in *Engineering News-Record* of Jan. 9, 1919, p. 107, brings up a question that must be settled sooner or later, and to which I believe consideration should be given now—that is, the question of properly allocating to the cost of goods transported over the highways by motor trucks their fair share of the cost of building and maintaining those highways.

Though I do not agree with Mr. Weller that the ton-mile cost is the proper basis for comparing the cost of motor-truck transportation with rail transportation, because the elements of flexibility of delivery and time of delivery demand careful consideration in determining the choice of method of transportation, I feel that he has brought up a very important subject for discussion when he reminds us that under present conditions the consumer of rail-transported goods pays his full proportion of the cost of roadway construction and maintenance, while the consumer of truck-transported goods shifts that portion of the cost to society as a whole. The exception to this would be in a state where motor vehicles were taxed as nearly as possible in proportion to their destructive effect upon the highway.

As an abstract proposition, that would seem to be the ideal solution of the whole problem; but I fear that the practical difficulties of equitably determining the rate to apply to each vehicle would be insurmountable, since neither weight or speed alone, nor the two together, are always the only or even the most important factors in determining the destructive effect of a vehicle.

There can be no doubt that within a moderate radius of the larger cities and between large cities situated comparatively close together, there is a marked tendency to transport all perishable and other high-class freight by motor truck, and it is probably but a question of comparatively few years until all of this work will be handled by motors, leaving the railroads to handle the through freight and the low-grade bulky freights.

This is going to mean an even more insistent demand than at present for good interurban roads and for wider roads to take care of the denser and—because of the rapid increase in the use of pneumatic tires on trucks—more rapidly moving traffic. Unless some satisfactory method of assessing the cost of building and maintaining these roads is worked out, the cost of these items is likely to be unjustly distributed.

As an instance, consider the State of New Jersey. The roads of that state, though the condition of many of them at present offers nothing to be proud of, represent the investment of large sums of money, yet I believe that more than half of the heavy traffic using the roads across the central portion of the state neither originates nor terminates in New Jersey and, naturally, the state receives no other revenue from this traffic than the small amount of the license fee from those trucks which are registered in New Jersey.

I do not, at this time, feel prepared to offer any solution of this important problem, but merely write because I feel, as Mr. Weller and many other engineers seem to feel, that we cannot have too much discussion on the subject. CHARLES F. DINGMAN.

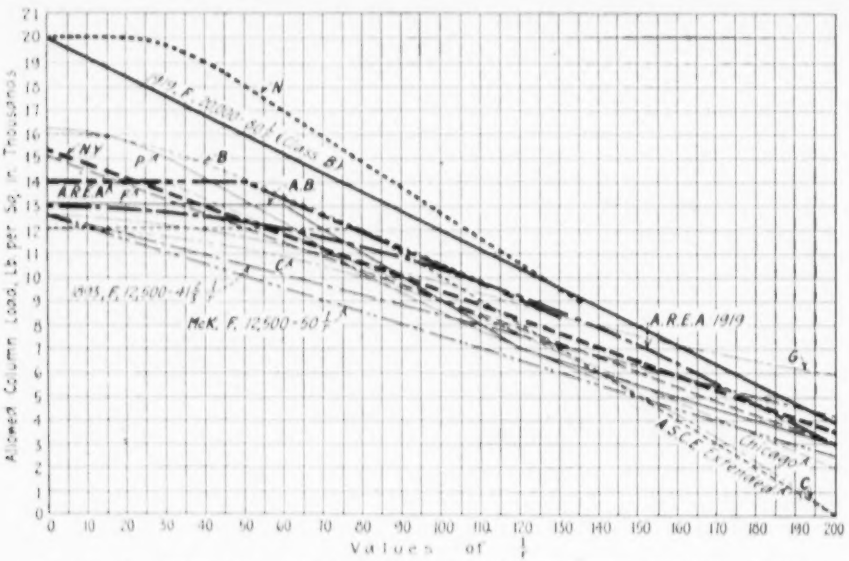
Palmer, Mass.

Restudy of Column Loadings to Unify Column Formulas

Sir—Dr. Waddell's letter in your issue of Jan. 16, 1919, p. 155, is along the lines of the discussion offered by me on the report of the Committee on Steel Columns and Struts of the American Society of Civil Engineers. Many engineers can testify that this report has caused a doubt to be raised among designers, and not only among those who have no ready means of verifying the basis for the formulas that they must use, but seemingly among many that should have confidence in what has been done in the past and in their long experience in designing steel columns.

That there was not unanimity of opinion among the members of the committee in propounding the formula $20{,}000 - 100l/r$, between the limits of 80 and 100 l/r, with a maximum of 12,000 lb. is certain, and it is to be regretted that there was not a minority report to call attention to the fact that the formula was not one having the approval of the entire committee, thus saving the whole society from having to stand sponsor for it before structural engineers and engineers generally.

However, there is yet time for the various societies to get together and make every endeavor to arrive at an agreement on one straight-line formula for each grade of material, and discard the dozen or more that are now in common use to a greater or less extent. There should be no doubt that the Engineering Institute of Canada, of which the writer is a member, would join in such a movement. Extended use has not yet been made of the new parabolic formula which they have recently adopted. That formula would cause a great deal of difficulty in designing long spans, especially such a structure as the Quebec cantilever, for which was used the formula $17{,}500 - 70l/r$ with a maximum of 14,000 lb. or, when all the stresses had been included and



A. B.	Am. Bridge Co.	19,000—100l/r	
A. R. E. A.	Am. Ry. Eng. Assn.	16,000—70 l/r	
A. R. E. A., 1919	Am. Ry. Eng. Assn. proposed	13,000—0.25(l/r)^2	
C	Eng. Inst. Canada	12,000—0.3(l/r)^2	
Chicago	Bldg. Code	16,000—70l/r	
F., 1893	Fowler's Spec., 1893	12,500—41$\frac{2}{3}$$l/r$	
F.	Fowler's Spec. (Cl. A.), 1919	15,000—60l/r	
F., 1919	Fowler's Spec. (Cl. B.), 1919	20,000—80l/r	
McK.-F.	Fowler, mod. by McKibben	12,500—50l/r	
N	Niagara, approx. Hell Gate	23,000—100l/r	
N. Y.	N. Y. Bldg. Code	15,200—58l/r	
Q	Queb. Cantilever	17,500—70l/r	
B	Boston Bldg. Code	16,000/[1 + P/20,000r^2]	
G	Gordon Formula	12,500/[1 + P/36,000r^2]	
P	Phila. Bldg. Code	16,250/[1 + P/11,000r^2]	
Maximum, Proposed for discussion		24,000—120l/r	
Lower limit diag. zone		12,000—60l/r	
Upper limit diag. zone		18,000—60l/r	

PRESENT FORMULAS FOR STEEL COLUMNS COMPARED WITH NEWLY PROPOSED FORMULAS

secondaries as well, a maximum of 18,000. This is for a medium steel with a yield-point of 35,000 pounds.

An investigation of the Niagara railway arch just carried out by the writer necessitated the careful study of the proper unit stresses to use, including column formulas; and as it was proposed to include all kinds of stresses in the totals, including secondaries and impact, the resulting total stress was in effect an equivalent dead-load stress, as is the case for any complete stress sheet at the present period. Therefore, the most logical column formula or curve of unit stresses for columns seemed to be one derived from the table of unit stresses, for the same class of steel and type of columns, established for the Hell Gate arch by Gustav Lindenthal. This is shown at the top of the annexed diagram, and is nearly 23,000 — 100l/r for the ordinary form of chord section and for steel with a yield-point of 33,000 lb., the maximum to be 20,000 lb. and the superior limit of l/r to be 135.

The diagram shows an essentially correct plotting of the principal column formulas that have received the sanction of engineers for various purposes, although some of them are of local adoption. All of the more commonly used ones lie in a zone between 12,000 — 60l/r and 18,000 — 60l/r, and the new Canadian and the proposed A. R. E. A. formulas lie in the same zone. The mean of these two, or 15,000 — 60l/r is of course at the center of the zone, and is practically the same as the formula of the New York City building code. This is what the writer had adopted for a 1919 edition of "General Specifications for Steel Roofs and Buildings," but now that a still more unsettled condition of this subject has come about, it would seem advisable to await an adjustment and an agreement by all concerned. The lower limit of the zone represents the ultra-conservative opinion, and the upper limit the approach to what must eventually be adopted if the seemingly ultimate conclusion is to be reached. The practice of adopting a maximum stress limit below a certain value of l/r is to the writer by no means rational if the columns are properly detailed, except in the case of the formulas like the topmost one, giving values in excess of 20,000 lb., or corresponding values for other grades of steel. The same formula for a given grade of steel might, however, be used for various classes of work, by adopting one set of limits of l/r for building work, one set of limits for highway bridges, and another set of limits for railway bridges. The maximum for such a formula might be considered 24,000 —120l/r, with a maximum of 20,000 lb., and of course making the rest of the specification conform to the formula. This would entail a study of whether to adopt the use of the net section in designing the columns of a structure, after the method developed by Mr. Lindenthal on the Hell Gate arch, and of many other seeming refinements. The loading to be incorporated in railway specifications is also inseparably tied up to the unit stresses, and seems quite far from a final settlement. The limits would, as stated, be much greater in the value of l/r for highway bridges, and greater still in the columns and struts for mill buildings and similar structures.

When we study the very unsatisfactory condition as shown by the diagram, it would seem to be only a logical course for the American Railway Engineering Association to ask for conference committees from the American Society of Civil Engineers; the Engineering Institute of Canada; the state highway departments; the building departments of the larger cities; the bridge division of the National Highways Association, and similar other interested organizations.

The necessity would then present itself, in arriving at the proper formulas, of a careful selection and plotting of all of the column tests of the past, and the more recent ones, such as those made by the American Society committee, and those given in the more recent report of the Bureau of Standards, using of course only those tests made on fairly well designed columns and those which are reliable from every point of view. The lower lines in the zone too often represent formulas that took account of tests of columns that were improperly designed and detailed. The matter of end conditions,

especially for high buildings, should be settled and plainly defined.

The parabolic curve C on the diagram, beginning at 12,000, is the Canadian formula $12{,}000 - 0.3\ (l/r)^2$, and that starting from 13,000 is the proposed formula of the A. R. E. A.—$13{,}000 - 0.25\ (l/r)^2$. While they are comparatively simple, it is by no means certain that it is wise to go back to curved formulas after having abandoned them to a very great extent in favor of the more-simple and, in the opinion of many, equally exact straight-line formulas. The restudy of all of the available data will, however, determine this to the satisfaction of all concerned.

CHARLES E. FOWLER,
Consulting Engineer.

25 Church St., New York City.

Corrects Statement of Levelman's Pay

Sir—Replying to the letter of R. Reimann in your issue of Jan. 30, 1919, p. 253, relative to the pay of a levelman *on a line now owned by the Baltimore and Ohio R.R.*, the line referred to was the Pittsburgh Southern R.R., acquired and now operated as the Wheeling division of the Baltimore and Ohio.

It is a matter of congratulation that the pay of levelmen is at least $145, which shows that there has been an advance.

E. N. GINEER.

Buffalo, N. Y.

Engineers' Salary Schedule Proposed

Sir—On account of the responsibility resting upon the railroad technical engineer for the success of transportation, it is important that he receive proper recognition in the way of pay. This is of interest and of importance to the public.

Had the engineer been adequately represented in the hearings before the Wage Board of the United States Railroad Administration prior to the issuing of Order No. 27, that order might not have been totally oblivious of his work. A conference of railroad technical engineers will be held in Chicago Mar. 17 to discuss economic questions of interest to the profession. Among these is the application of overtime rules of the Railroad Administration. Many engineers are opposed to overtime on the ground that it does not permit the best work. They hold that the monthly salary should be adequate and that overtime should not be considered.

The inclosed schedule, which was prepared by the American Association of Engineers and approved by its railroad committee, consisting of W. H. Finley, E. H. Lee and W. W. K. Sparrow, is the first attempt made by an organization of engineers to say what salaries should be paid. This is not a final schedule but a preliminary one, and comment is invited. It is being sent to managers and to others interested in this subject. You will note that there is no attempt made to take up specialties in the railroad field, but it does lay the groundwork for uniformity in classifying the various positions in railroad engineering departments.

Chicago, Ill.

C. E. DRAYER,
Secretary, American Association of Engineers.

Over $5,000,000,000 Worth of Minerals Mined

Mineral products worth more than $5,000,000,000 were produced by the mines of the United States in 1918, according to estimates by the United States Geological Survey. This, it is estimated, is more than $150,000,000 increase over 1917, and nearly $2,000,000,000 more than 1916. The estimates show that the output of pig iron, copper, ferro alloys, lead, zinc, gold, silver and aluminum was valued at slightly under $2,000,000,000 in 1918, as against a little more than $2,000,000,000 in 1917, whereas the nonmetallic products, the principal of which are coal, petroleum, clay products, cement and natural gas, were valued at more than $3,250,000,000 in 1918, as against less than $3,000,000,000 in 1917. These figures, as announced, are preliminary estimates of the production of 1918.

SCHEDULE OF MONTHLY SALARIES FOR TECHNICAL ENGINEERS RECOMMENDED BY AMERICAN ASSOCIATION OF ENGINEERS

	Monthly Salary: Railroads Having Over 5,000 Miles of Track	Monthly Salary: Railroads Having Less Than 5,000 Miles of Track
Chief engineer: In charge of entire railroad system, responsible for all engineering work and organization, including valuation	Salaries commensurate with duties performed	
Assistant Chief Engineer: In charge of portion of line or entire territory; reporting to chief engineer; responsible for such work as may be assigned to him by the chief engineer	Salaries commensurate with duties performed	
District Engineer: In charge of two or more divisions; reporting to assistant chief engineer in charge of that territory; responsible for all maintenance of way and minor construction	$425	$375
Assistant District Engineer: Same territory as district engineer—like responsibilities. Reporting to district engineer	350	300
Division Engineer: In charge of one division; responsible for all maintenance of way and permanent way work	375	350
Resident Engineer: In charge of one residency; reporting to division engineer. In charge of construction work only. This position not required for maintenance of way or permanent way work	275	275
Assistant Engineer: Acts as assistant to division engineer, assistant district engineer, and assistant chief engineer. Responsible for such duties as may be assigned him	275	275

	Salaries commensurate with duties performed	
Chief Draftsman: Reports to chief engineer or assistant chief engineer; in charge of general drafting room at principal headquarters		
Engineer of Bridges: Reports to assistant chief engineer or chief engineer. Responsible for maintenance and construction of all bridges—wooden, steel and concrete	400	350
Valuation Engineer: Responsible for all valuation work on entire system. Reports to assistant chief engineer or chief engineer	400	350
Assistant Valuation Engineer: Reports to valuation engineer; has like responsibilities	350	275
	Permanent Work, One Year or More	Temporary Work, Less Than One Year
Instrumentman: Reporting to engineer or chief of his assigned department	$200	$225
Rodman: Reporting as assigned	125	150
Tapeman: Reporting as assigned	100	120
Designer: Reporting to chief draftsman or as assigned, and qualified to prepare original design on engineering or architectural work	250	275
Draftsman: Reporting to chief draftsman or as assigned, or general drafting work involving general detailing	160	200
Junior draftsman: Reporting as assigned and qualified for general drafting room work	115	160
Tracer: Reporting as assigned, and qualified to prepare neat tracings on special designs	110	130

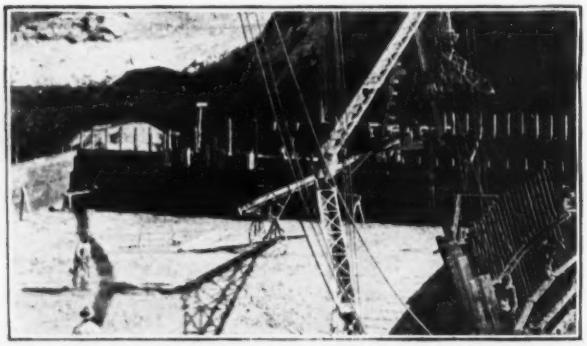
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Home-Made Bicycle Support for End of Concrete Chute

IN THE construction of the Gibraltar dam, near Santa Barbara, Cal., there was built on the job a two-wheeled support for the end of the concrete chute. This device made it easy to shift the delivery end of the chute, thereby saving the expense involved in a separate block-and-tackle support or the delay occasioned in moving when the delivery section is supported on a trestle.

As shown in the accompanying illustration, the "bicycle" was made up of two wheels taken from an ordinary concrete buggy and mounted on a frame built



THIS CHUTE HAD BICYCLE TO RIDE AROUND ON

up of scrap-iron and short pieces of old pipe. By putting a through bolt and nut in the head of the fork supporting each wheel, and keeping the bolt fairly tight, the wheels could be kept steady in any direction after being aligned by hand. Thus, for moving ahead the wheels would be directed at right angles to the frame, or for swinging around the swivel joint they would be placed parallel to the frame, and wherever placed would retain their relative positions as the end of the chute was moved to a new location.

A slope of 3 to 1 was standard for concrete chutes on the job, so the irons used to attach the bicycle frame to the chute were made accordingly. To change the device to another section of chute it was only necessary to remove the bolts, two on either side where the frame was attached to the lip of the chute, and make the same connections on the new chute section.

The device was developed by Mr. Slocum, one of the superintendents for Bent Bros. and W. A. Kraner, contractors on the Gibraltar dam.

Camp Drinking Fountains Improvised From Barrels

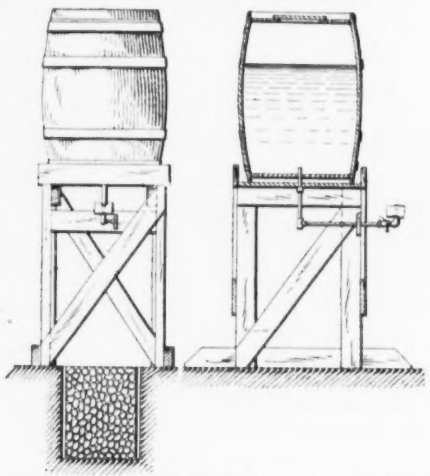
DRINKING water was distributed by means of bubbling fountains improvised from barrels to workmen constructing the extension to Camp Custer. As shown by the drawing, 50-gal. casks were mounted

Other Articles in This Issue of Interest to Contractors:

Mammoth Derricks Build Concrete Outlet for Lockington Dam — Page 326

Preparing Six Hundred Acres of Land for Irrigation — Page 337

upright on stout wood frames 2 x 2 x 3 ft. A half-inch connection in the cask bottom connected with ¾-in. pipe to the bubble jets. These were set in ordinary pint tin cups so that the lips of the drinkers would not touch the jets. The jets were also slightly inclined to prevent the water from falling back on itself. Perforations in the tin cup permit it to drain out. To prevent formation of a puddle to breed mosquitoes a sump, as shown, is built under the bubblers. This sump



BUBBLING FOUNTAINS SUPPLY DRINKING WATER TO WORKMEN AT CAMP CUSTER

is 1 x 1 x 1½ ft., and is filled with broken stone. The barrel is filled through a hinged door in the top.

At the height of operations, when the working force was about 2500, one driver and two helpers with a wagon kept all the fountains supplied with fresh water.

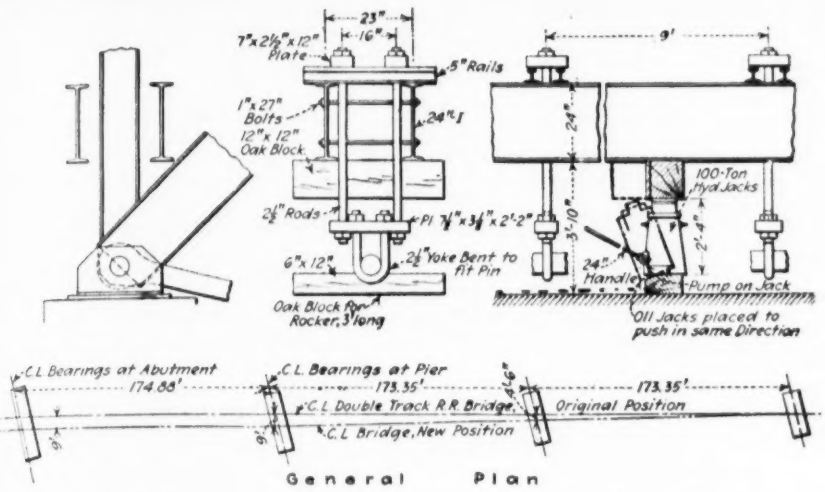
Camp Custer was built by the W. E. Wood Co., Detroit, Mich., contractors, under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greeley, supervising engineer.

Skew Bridge Spans Shifted Laterally by Jacks on Rocker Blocks

BY S. A. SNYDER

Field Superintendent, The Foundation Co., New York City

A UNIQUE method of shifting bridge spans was recently applied successfully at the Delaware River bridge of the Central R.R. of New Jersey at Easton, Penn. Three 174-ft. double-track railroad spans were



DETAILS OF JACKING SCHEME FOR SHIFTING BRIDGE SPANS LATERALLY

shifted 9 ft. south when it became necessary to build a new bridge of heavier design alongside of the old bridge. The sketch herewith indicates in outline the details of the method used. An acetylene torch was first applied to cut through the plates of the main shoes, which were made in one piece and had to be divided in order to allow independent movement of the spans.

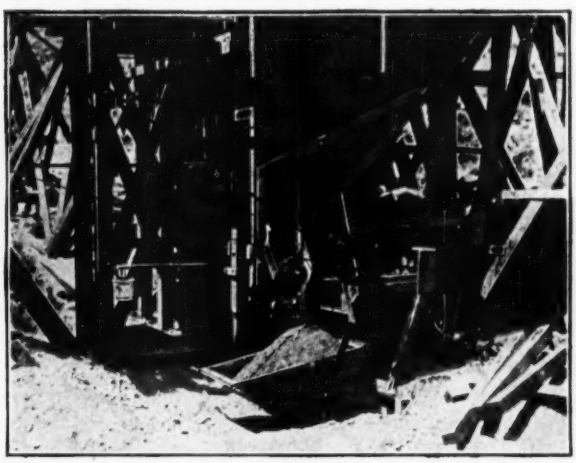
A special yoke, of 2½-in. diameter, bent into the shape of U-bolts with 3½ x 7-in. steel yoke plates, was made fast under the end pins. Hanger bolts carried the load to the 24-in. 80-lb. I-beams, as shown in the sketch, by the 5-in. rails laid across these beams and the 7 x 2½-in. plate on top. Oak blocks, 12 x 12 in. in size, were fastened to the under side of the beams with nails, and below them 100-ton hydraulic jacks were erected upon the rocker blocks 6 x 12 in. in size.

Twenty-two jacks in all were used, and two men were stationed at each. At the given signal all started pumping at once; when the spans lifted the jacks rolled on the rocker blocks, moving sidewise and endwise at the same time to allow for the skew. The movement was made in six working hours by The Foundation Co., 233 Broadway, New York, with the writer as field superintendent, under the general direction of A. E. Owen as chief engineer of the Central R.R. of New Jersey.

Single Line Automatic Dump Skip Makes Speedy Record

TO ELEVATE mixed sand and gravel to screens, on the dam near Santa Barbara, Cal., a wooden skip was designed to be operated on a cableway by a single line, and to dump automatically. The skip was supported from a two-wheeled carrier, as shown in the illustration, in such a way that when full it balanced in a stable position. The forward end of the skip carried a round bar projecting on either side. As the skip passed over the bunkers these projections were caught by slots in a pair of rails, thus stopping and holding the forward end. Then, as the carrier was advanced a few feet farther, the skip would revolve around the pins on which it was supported, and turn over into dumping position. The slope of the forward end of the skip, as shown, insured a clean delivery of materials. The weight of the skip and the steep angle of the cableway (something over 30 degrees) were found sufficient to secure a prompt return to the loading point when the hauling line was slacked away. The skip was built up on the job partly for economy and partly because all equipment for this work had to come through a tunnel with a maximum clearance of 42 x 46 inches.

The skip was devised by W. A. Kraner, of Bent Brothers and W. A. Kraner, contractors on the dam, and worked so successfully that two of them will be used when the work is resumed after the season's high water. During the season just closed the skip regularly made



THIS SKIP SAVED MONEY FOR THE CONTRACTOR

a round trip per minute, handling 50 cu.ft. of material on a 185-ft. lift.

Cost of Resurfacing Street Excavations in Los Angeles

Resurfacing of street excavations to the amount of 579,062 sq.ft. has been done at Los Angeles for the following unit costs, according to the annual report of the Engineering Department. The names of the various pavements included and the unit cost per square foot for replacement are as follows: Asphalt, 27.31c.; macadam, 16.16c.; brick, 33.34c.; granite block, 18.67c.; concrete, 17.58c.; oiled gravel, 10.51c.; streets not oiled, graveled nor paved, 0.42c.; sidewalks, 18.69c., and curb per linear foot, 43.39c. All excavations are taken care of by city forces under the supervision of a city foreman, which method is reported to be both satisfactory and economical.

NEWS OF THE WEEK

New York, February 13, 1919

Conference Promotes "Build Your Own Home" Movement

Discusses Legislative Measures Whereby Loan Association Securities May Be Made Available

At a recent conference held in Washington ways and means were discussed by which legislation may be enacted to make negotiable the securities of the building and loan associations, for the purpose of financing the "Build Your Own Home" movement. The conference was called by F. T. Miller, director of the Division of Public Works and Construction Development, Department of Labor, and was held in the offices of the division in Washington, D. C. A number of delegates representing the legislative committee of the United States League of Local Building and Loan Associations were present.

It was announced by Mr. Keesler, president of the league, that a caucus had been held previously to the meetings. The Solicitor of the Treasury was present at the caucus, which decided informally upon the following:

"A law should be advocated modeled somewhat upon the Federal farm loan act and somewhat upon the provisions of the act establishing the Land Bank of the State of New York—in other words to establish home loan banks in each Federal Reserve district, providing for small fixed capital and safeguarded by proper restrictions, of which banks the local building and loan associations would become stockholders. These would be authorized to accept building and loan collateral from member associations and issue debenture bonds therefor. Such bonds and the assets of the home loan banks would be declared instruments of the United States Government and exempt from taxation."

The league has a membership of 7269 associations with a collective individual membership of 3,838,612. It was stated that it had loaned all its available money and that it was now six months in arrears in making loans. In the present condition of affairs, the members are unable to assist the construction movement because of the non-negotiability of their assets, but, it was pointed out, if this could be remedied, the associations could make loans for home-building purposes to a very large extent.

Their assets, it was stated, which are estimated at $2,000,000,000, are for the most part first real estate mortgages. These are not acceptable at the Federal Reserve or national banks, and in many states are not transferrable by state.

(*Concluded on page* 350)

American Delegates to Paris Engineering Congress Report Conditions in France

Describe Waterways, Road Situation, Lens Mines, Hydro-Electric Conditions and Ports—Franco-American Commission Proposed

That French engineers do not desire help from American engineers, except certain specialists, was again emphasized at a large meeting of the New York members of the four national societies in the auditorium of the Engineering Societies Building on Feb. 10. Most of the delegates to the French engineering congress in Paris were present and informally reported on the trip to France and their impressions of the French attitude and engineering conditions there. Col. H. S. Crocker, vice-president of the American Society of Civil Engineers, presided.

This delegation was invited by the *Société des Ingénieurs Civils* to visit a Paris Congress of Engineers, as described in our issue of Nov. 28, 1918, p. 1003, and attended various sessions and committee meetings from Dec. 16 to Jan 18. A significant action of the Congress was reported—it proposed a permanent Franco-American International Commission.

Dr. George F. Swain, past president of the civil engineering society, who was made chairman of the delegation after Maj. J. S. Case left for Italy, described the work of the Congress and stated that it included public men and business men. M. Millerand, former Minister of War of France, was chairman of the Congress. It was desired to consult American engineers with reference to three problems: (1) Changing war industries to a peace basis; (2) rebuilding the devastated districts, and (3) the great engineering problems. The last were discussed by the Congress through committees on ports, navigable waterways, roads, waterpower, and technical education. Reports are to be prepared by the American delegates and sent back to the Congress.

Dr. Swain described their visits to various ports in southern France, Grenoble, Marseilles, and Lyons, where they were entertained by the Chambers of Commerce, and said that French engineers are anxious to coöperate and learn American methods, having been surprised by the speed of the Army construction in France. He reported the action of the Congress in voting to ask for the permanent Franco-American International Commission. The delegates left a preliminary report, answering questions and commenting on the action of the Congress on various subjects.

NAVIGABLE WATERWAYS AND TECHNICAL EDUCATION

Dr. Swain stated that France had spent more than any other European country in improving her inland waterways and expected a great increase of commerce through her ports to replace Hamburg and Bremen, and that they are making plans for developing canals and navigable rivers. He commented on the lack of economic studies, and comparison with railroad costs. The state assumes all the burden; but he claimed that the present emergency required more economic study to insure sound economy.

Technical education in France is more theoretical than in this country, but many changes in their educational methods are being considered. The desirability of exchanging students with France was discussed at the Congress, and hopes were expressed that more American students would go to France for technical study, rather than to Germany as in the past. The French are hoping to change their previous restrictions, which have discouraged the attendance of American students.

Employment

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western zone, 63 E. Adams St., Chicago.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

George W. Tillson, one of the civil engineering delegates, discussing the roads situation in France, stated that the French wish to build for permanence, but are very conservative. They believe in the use of asphaltic macadam, using the penetration method rather than the mixing method, apparently because the latter is more costly in requiring larger plant. The American engineers urged concrete and brick for such permanent roads.

Mr. Tillson discussed the methods of financing for road building, stating that many French roads are paid for by fifteen annual instalments, the cost thereby being at least 65 per cent. more.

E. G. Spilsburg, who represented the Institute of Mining Engineers, described a trip to Lens and the devastation in the coal region. He stated that not a building was standing in Lens, where there were sixty mines, eighteen of which were operating before the war. All the head frames had been leveled, being pulled over by motor trucks after the legs were cut by oxy-acetylene flame, if they had not been blown down by shells. The mines were flooded by laying pipes from the Somme Canal. He stated that it would require 30,000 horsepower per year to unwater the mines, and that probably coal mining would begin about nine months from next spring. He insisted that the French were not seeking the help of foreign engineers, except specialists; they expect to use their own machinery and man power.

Agriculture, Finance and Hydro-electric Power

George W. Fuller, one of the civil engineering delegates, discussed the subject of agriculture and finance, saying that France had increased her government expenses by at least $2,000,000,000 per year as a result of the war and had lost 2,000,000 men from active life. The transition to peace is relatively slow, the rehabilitation program being quiescent, due to the fact that the railroads are tied up in rationing Belgium, Alsace-Lorraine, and French devastated regions. The French are inclined to wait for the results of the Peace Conference, and the reparation and indemnity funds to be asked from Germany. They also await Parliamentary elections soon to occur.

Lewis B. Stillwell described the three regions for waterpower development in France—the Alps, drained by the River Rhone, the Pyrenees, not yet much developed, and the highlands in the south of France, where low heads are available, with good locations. The total estimated horsepower developable is from 4,500,000 to 6,000,000. After mentioning some of the historic developments of high-head plants, he stated that we could teach the French nothing in the technique of hydroelectric application to industry, except perhaps in the magnitude of operation. An electrolytic process for making iron pipe by depositing iron on drums was described, the plant being near Grenoble. The French believe in taking industry to the waterpower. The delegation's preliminary report recommended that the coal regions should be connected up with the waterpower centers. They are making a serious effort to standardize frequency and potentials, so as to allow inter-connection in the future—a frequency of 50 has been recommended by the Paris Congress.

Port Development—Marseilles Trip

A. M. Hunt—one of the civil engineer delegates—described the port developments in France and the French plans for an east and west railroad to Basle, Switzerland. They expect to act promptly and one plant is already being developed at Saint Lazaire. They ask a report on the methods of handling freight at ports in America, especially for ports where there is a great range of tide, 16 to 20 ft., as in France. Floating docks are also greatly needed.

One of the most stirring addresses of the evening was the last, by Nelson C. Lewis, a civil engineer delegate, describing the "Smiling Valley of the Marne" which they passed through on the first sunny day of their trip. He pictured the great changes in France, the separation of families, and the question was raised whether many of those who are now in southern France would desire to return to the devastated districts. The problem of women in industry is causing serious complications, and the French are attacking the industrial essentials before they can return to their artistic development. He cited the figures on the devastated areas, which include 6000 sq.mi. in the north of France, quoting the total as $13,700,000,000 as the estimated amount of this destruction and pleading for the necessity to force Germany to pay every cent of this as reparation.

Position Offered Parsons as Transit Construction Commissioner

Governor Smith of New York has offered to Col. William Barclay Parsons the position of director of rapid-transit construction in New York City. Colonel Parsons is still in France, and a reply to the offer has not yet been received. According to the Governor's recommendation to the legislature, regulation of public utilities is to be separated from the direction of construction work, and a single commissioner is to administer the latter. Up to the present the legislature has not acted on the recommendation, but some form of revision of public-utility work in New York State is considered certain.

Departments Report on Canals

Two reports relating to canals have just been made public by Congress. One is a report from the Secretary of Commerce to the Senate on the Atlantic intracoastal canal system; the other, a report from the Chief of Engineers through the Secretary of War to the House of Representatives on the Houston ship channel in Texas. The Atlantic canal report goes thoroughly into the proposed canal system paralleling the Atlantic coast and some distance back from it. It includes descriptions of the Cape Cod Canal, the New Jersey Canal and the Chesapeake & Delaware Canal, all of which make up the proposed connected system. The Houston report is in effect a recommendation by the Chief of Engineers to extend this channel, which now connects the hitherto inland city of Houston with the Gulf of Mexico.

An Innovation in Motor-Truck and Good-Roads Boosting

In Macon, Ga., an innovation is being undertaken by the Chamber of Commerce to promote the use of motor trucks for hauling produce and freight to and from the suburban districts. The test will take place Apr. 3, and more than 250 trucks will be used.

The plan is to have six motor-truck fleets leave the city in six directions, proceeding to terminals approximately the same distance from the city. On the outgoing trip they will be loaded with merchandise, and on the return trip with livestock and farm products. A parade in Macon before the start and a rally at each terminal point, with stops along the way, will be used to advertise the experiment.

Motor-truck dealers and manufacturers, together with merchants and farmers, have promised their coöperation, and it is planned to have with each train specialists whose duty it will be to record every phase of the test, including mechanical operation and cost, bridge and road conditions, tonnage, time, etc. The plan is to demonstrate what can be done with motor trucks over good roads.

Engineering Council Appoints License Committee

The question of the licensing of engineers has been taken up by the Engineering Council, and a license committee has been appointed, with the following members: Chairman, T. L. Condron, Chicago, Ill.; F. C. Shenehon, Minneapolis, Minn.; Farley Gannett, Harrisburg, Penn.; John H. Dunlap, Iowa City, Iowa; Arthur M. Greene, Jr., Troy, N. Y.; Caleb M. Saville, Hartford, Conn.; James H. Herron, Cleveland, Ohio; A. M. Schoen, Atlanta, Ga.; John Klorer, New Orleans, La.; Philip N. Moore, St. Louis, Mo.; A. Lincoln Fellows, Denver, Colo.; C. H. Snyder, San Francisco, Cal.; and Amos Slater, Seattle, Wash.

The country is being divided into districts by the chairman, to be assigned to the various members of the committee for the gathering of information from state officers and others, relative to existing and proposed legislation on the subject of licensing engineers and architects. The committee is already receiving inquiries for information, and assistance on this subject from many quarters.

Build a Home Movement

(*Concluded from page* 348)

law. Because of the excellent character of the securities, members of the associations were of the opinion that they would be able to rediscount at a comparatively low rate. The associations, it was said, did a business in 1917 of $1,250,000,000, at an expense of 0.00875 per cent.

Motion Pictures Show Essentials In Making Concrete

At the meeting of the American Society of Civil Engineers in New York City Feb. 19 Nathan C. Johnson, consulting concrete engineer, will present a moving-picture film which illustrates the essentials, in materials and mixing, in the making of good concrete. The film embodies the results of Mr. Johnson's five years' study of concrete with the microscope and the motion-picture camera. The early results were presented in *Engineering Record* of Dec. 4, 1915, p. 684.

The film takes up the materials and processes through which they are put, examining each material and each step in the mixing and placing in its effect on the final product. The effects of erroneous methods are shown as well as those of correct procedure. Throughout the film, which consists of two and a half reels, are full explanations of the various parts of the picture, so that it is entirely self-explanatory. However, in presenting it Mr. Johnson will use a type of projector that allows the film to be stopped for any length of time, so as to permit full explanation and discussion.

Among the most interesting features are sections of the film which show setting and other operations; this picture was taken over long periods. One particular portion was made with exposures extending continuously over 50 days, a motor-driven camera being used for the purpose.

Kansas Engineering Society Wants State Aid for Roads

At the annual meeting of the Kansas Engineering Society held at Topeka, Jan. 30-31, the retiring president, C. M. Buck, pointed out the necessity for hard-surfaced roads, and urged the society to use its influence with the state legislature to have measures passed allowing state aid on roads and bridges and increasing the salaries of county engineers. A special legislative committee was appointed to prepare resolutions.

Dean Shaad, of the school of engineering of Kansas University, spoke on engineering education, emphasizing four main points: (1) Vocation schools; (2) designing, covering the courses generally included in a technical curriculum; (3) executive and administrative, covering special courses in these fields; (4) good citizenship, taught in the entire course.

Lieut. K. P. Cecil discussed the subject of artillery at the front, explaining three methods of range-finding—the three-point-sound method, the flash range, and the high-burst range, where trial shots are made above the target that they may be observed by the range-finders. The Lambert system of co-ordinates as used in mapping the battlefield was explained. Capt. L. R. Tillotson presented a paper on "With the Engineers in France." He praised the roads of France, and said that they were a key to the success of the army. Railway and harbor improvements were described in detail. Maj. Clark Mandigo gave a short description of some of the engineering construction that was undertaken at the front.

Resolutions were adopted to be submitted to the four national engineering societies, requesting their aid in the matter of increasing salaries. The following officers were elected: President, A. A. Potter, dean of engineering, State Agricultural College, Manhattan; vice-president, H. A. Rowland, McPherson; secretary-treasurer, Lloyd B. Smith, Topeka.

Research Assistantships Available at University of Illinois

There will be eight vacancies in the research graduate assistantships, Engineering Experiment Station, University of Illinois, Urbana, Ill., at the end of the current academic year. Two other such assistantships in gas engineering have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $500 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry.

Nominations, made from applications received by the director of the station not later than Mar. 1, are subject to the approval of the president of the university and are based upon the character, scholastic attainments and promise of success in the principal line of study or research to which the candidate intends to devote himself. Preference is given to those applicants who have had some practical engineering experience following the completion of their undergraduate work.

Bill Introduced To Promote Industrial Education

Representative Caldwell of New York on Feb. 4 introduced a bill into Congress to provide for further educational facilities by requiring the War Department to loan certain machine tools not in use for Government purposes to trade and technical schools and universities. Each institution so equipped shall be responsible to the United States, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

Technical Editors Make Trip to War Areas of Europe

Notes on Journey of Observation to England, Belgium and France at Invitation of British Government

Last October Great Britain, through its Ministry of Information, invited a party of 15 editors and publishers of technical and business papers in the United States to visit England and France, in order that civilian intercourse might continue in spite of the obstacles interposed by military regulations. While in Europe the travelers attended many social functions, but back of the luncheons and dinners there was a serious purpose, the former being merely the medium chosen for its accomplishment. It was a tribute to the technical and business press of America of which, says one of the returning editors, we may well be proud.

Notes of the Trip

The following notes have been abstracted from an article by one of the party, H. C. Parmelee, editor of *Chemical and Metallurgical Engineering*. Among others on the trip were Samuel O. Dunn, editor of *Railway Age*, Chicago; William W. Macon, managing editor of *The Iron Age*, New York; Floyd W. Parsons, editor of *Coal Age*, New York; H. C. Estep, editorial director, Penton Publishing Co., Cleveland; and Arthur J. Baldwin, vice-president of the McGraw-Hill Co., Inc., New York, Mr. Parmelee writes:

"Before leaving England we were entertained at luncheon by Lord Northcliffe, owner of the London *Times*, at Printing House Square. For this occasion our host had invited leaders of industry and political thought to meet and talk with us, and we counted the affair one of the most instructive we had attended. Sir Robert Hadfield spoke of the possibility of giving workmen a summer holiday with pay instead of making them take their holidays on their own time.

"A brief visit to Sheffield University allowed an hour with Prof. J. O. Arnold, who is at the head of the department of metallurgy and engineering.

It is greatly to be regretted that work such as that Professor Arnold has done and is doing is not adequately supported. It seemed to me as though England had not yet risen to an appreciation of her technical men, despite the fact that they were the ones on whom she had to call when she was confronted by a foe skilled in technology and the application of science in the art of warfare. I was told that the Government had actually contemplated providing chemists for some of its works with the munificent salary of £125, about $625, per annum, a sum which would not attract a bottle washer in our American laboratories. This was but one instance of what seemed to me to be a lack of appreciation of

technical education, but I was told that a change is coming and that England is alive to the needs of research, coordination of industry and universities, and the value of technology in the national life. Incidentally, some excellent work has been done by such men as Professor Arnold and Sir Robert Hadfield, and we may expect some good papers from their pens.

"France gives one the impression of being somewhat dazed over her recent experience, and at a loss to know just where to begin to retrieve her lost fortunes. We had a number of dinners and luncheons with their leaders of industry, who said frankly that France was in the position of having to ask preferential treatment at the hands of the other nations. One gentleman even suggested that they would like to see French goods enter the United States duty-free, and American goods pay a duty on entering France. They are alarmed at the prospect of the Germans capturing world markets before France can even rehabilitate her factories and get new machinery in running order. The Germans return to factories that are intact, ready to turn out their products into world trade, while France must begin at the bottom and build again her principal industries. These are the things that worry France and are probably having something to do with the new terms in the extension of the armistice.

GAINED A NEW POINT OF VIEW

"We landed in New York on New Year's Day, glad that our home is in the U. S. A., but not forgetting the ties that must inevitably bind us closer to our English-speaking friends on the other side. One cannot experience two months of travel in foreign lands and contact with peoples with whom we have been united in a vital struggle without getting a new point of view, broader, larger, more comprehensive and sympathetic. We have been deeply impressed with the endurance and fortitude of the British and French, and we can but admire the high ideals that animate them in their approach to the solution of problems that concern the world's future welfare. Our own participation has been deeply appreciated, so much so that we are likely to be led into exaggeration of the importance of our part in the great struggle. At the same time our help is just as urgently sought in meeting the problems of peace, and to that end we must all lend sympathetic and broadminded aid."

No Federal Aid for Hudson Tunnel as Postal Route

Vote of the United States Senate, Feb. 7, defeated the Calder amendment to the Post Office appropriation bill authorizing Federal participation in building a vehicle tunnel under the Hudson River at New York. The amendment was held to be in order, but a vote on its adoption defeated it, with 12 votes in favor to 48 against.

Castle Formation by Engineers On Last Day Under Arms

The accompanying photograph of the 209th Engineers, Camp Sheridan, Alabama, was taken on their last day under arms, Jan. 21. The men were photographed from a tower 40 ft. high. The camera was 5 ft. higher, and the nearest edge of the castle formation was 57 ft. away.

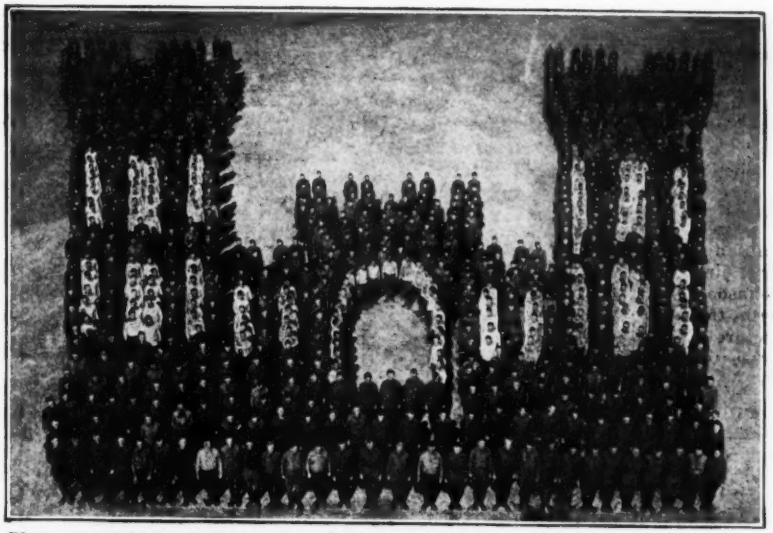


Photo copyright by G. F. Jennings, Montgomery, Ala.

209TH ENGINEERS IN CASTLE FORMATION PHOTOGRAPHED FROM 40-FOOT TOWER AT CAMP SHERIDAN, ALABAMA

The design called for 1000 men to fill in the castle, but only 925 were used. The design was made by Capt. D. C. McConnell, regimental topographical officer. A camera with a focal length of 14 in. was used. Col. Beverly Dunn, Engineers, was the commanding officer, and Lieut. Col. H. F. Cameron was second in command.

Propose To Take Office of County Engineer Out of Politics

Abolition of the elective office of county engineer in the State of Washington and the substitution of a superintendent of highways, appointed by the county commissioners to serve as long as he proves efficient, are the purposes of a bill that has been introduced in the state legislature now in session at Olympia. The bill is recommended on the ground that it would take the county engineer's office out of politics.

Qualifications of the superintendent of highways are set forth and include as a requisite that he shall be a civil engineer of recognized standing, shall have had a degree conferred by some college or university having recognized courses in civil engineering, and shall have practiced his profession in connection with highway engineering or railway engineering for two years, or, in case he does not hold such degree, he shall have practiced his profession for five years. The bill requires a bond in the sum of $5000.

The state shall pay the superintendent $100 a month, with traveling expenses, to be paid out of the county current expense fund. The bill contemplates that each county shall pay the superintendent an additional salary, the total not to exceed $5000 per year. It would make the county commissioners agents of the state highway department, and require that they appoint a competent engineer to work under direction of the department.

To Build Devil's Gate Dam

Bids for the construction of the Devil's Gate dam, a portion of the project to control floods in the Arroyo Seco, will be received by the Board of Supervisors of Los Angeles County, California, on Feb. 19. The estimated cost of the dam and appurtenances is $290,000. The structure will be an arch dam, with a maximum height above the stream bed of 100 ft. and a crest length of 310 ft. Cyclopean masonry will be used. On top of the dam there will be a roadway 20½ ft. wide and two 4½ ft. sidewalks. Besides a spillway with 10 openings, each 10 x 11 ft. in size, there will be an outlet tunnel. The latter will be controlled by three 7 x 9 ft. sluice gates. The site of the dam is near the northwest corner of the City of Pasadena. The drainage area above the site is 30 square miles, and the estimated maximum discharge is 11,400 sec.-ft. The proposed contract calls for beginning work within 30 days after the award and for completion by Dec. 19, 1919. The purpose of the dam is to control the flashy winter floods on the Arroyo Seco, a stream which joins the Los Angeles River near Elysian Park. J. W. Regan is chief engineer for the project.

Active Construction Delays As Labor Unrest Increases

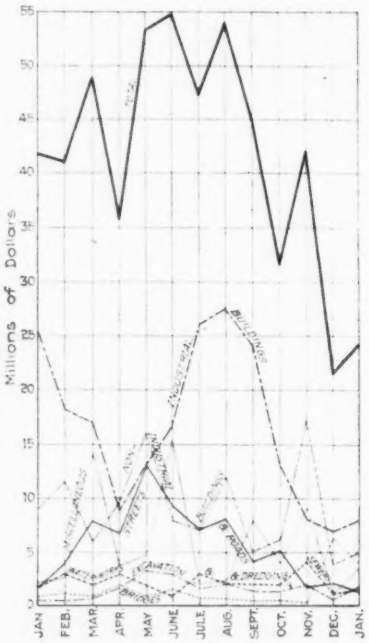
With Work Under Contract Millions Less Than Year Ago Proposed Work Shows No Advance Over Last Month

A survey of contracts let and projected work reported to *Engineering News-Record* shows that the hoped-for construction boom has not yet started. Contracts let, as indicated in the accompanying diagram, total some $20,000,000 less than those reported a year ago, and do not include the cantonment and other heavy war construction of the Federal Government at that time.

In an effort to learn the amount of public work that will be undertaken in 1919 *Engineering News-Record* sent letters and telegrams to all state highway departments, to state architects, and to city engineers of municipalities down to 50,000 in population. Of the replies received those on highway work were the only ones that were even approximately complete, and they totaled but a little over $350,000,000 for the year, which is only a small fraction of the annual amount of road work usually carried on throughout the country in normal times. The replies on municipal work were so fragmentary that they give no indications as to the probable trend of work, less than $60,000,000 worth being reported. A majority of the replies, however, show that, although the engineers were prevented from giving definite data on account of incomplete budgets, etc., they were alive to the gravity of the situation and were bending their efforts toward getting as much work started as possible.

The campaign for emergency construction started by the War Labor Policies Board in Washington deserves credit for some of this activity, the members of the board having made strenuous efforts to stimulate work to the utmost. Questionnaires have been sent to every city in the country to get information to enable the War Labor Policies Board to make a survey of the anticipated demand by municipalities for capital and labor. The data from the replies to date are still incomplete, but so far approximately $50,000,000 is reported, for which funds are already provided, $80,000,000 for work already authorized, the money to be raised by bonds, and $40,000,000 for work already, or likely to be, authorized and to be paid for by tax levies. Although small, these figures, it is believed, are more definite than those given in the table, since much of the latter amounts were derived from estimates. The figures in the table represent thousands of dollars.

It is evident, however, that the real start of construction work has not yet been made. It will be noted in the table that the proposed building construction amounts to but a bare $200,000,000, in spite of the dearth of building throughout the country and that contracts let in January amounted to less than $5,000,000. The amount of building construction in any one year cannot be definitely determined, but the pre-war work is variously estimated as amounting to between $2,000,000,000 and $3,000,000,000 annually. The war-



MONTHLY VOLUMES OF CONTRACTS LET REPORTED BY "ENGINEERING NEWS-RECORD"

time restrictions and the increase in population have been such that builders believe that for the next five years building construction will average in excess of $3,000,000,000 annually. It is evident that if the labor situation is to be relieved much heavier amounts must be reported than these to consider the work as even having started. The Bureau of Public Roads estimates that for every $1,000,000 worth of road work only 1000 men are employed, so that even should the total amount of estimated road work as shown in the table be converted into active projects, it would absorb less than 400,000 men. The Bureau of Public Roads recently requested the various state highway departments to send in an estimate of the requirements of labor that would be needed on the road work in the various states. Thirty-eight states replied, but only 29 gave definite figures. They report that they can use approximately 12,000 soldiers and sailors as skilled laborers, and slightly over 19,000 as unskilled. Those classed under skilled labor include masons, carpenters, quarry bosses, concrete finishers, road foremen, roller men and superintendents. Unskilled laborers were not classified.

Holding out for better prices of labor and material is, of course, the key reason for the delay. Better prices are hoped for, and a saving on construction work generally is believed possible by waiting.

The material men say, however, that there will be no decline in prices. Labor has stated that wages will not be reduced, and the owners, architects and builders are holding off for a more favorable season. Commenting on the situation, a prominent engineer in the cement industry pointed out the fallacy of the waiting, in that the threatened upheaval that will surely come if relief is not promptly forthcoming will be far more costly than the prosecution of work at the prevailing high prices.

CONSTRUCTION WORK PROJECTED FOR 1919

[*All Figures in Thousands of Dollars*]

	Reported by Construction News December	Construction Section January	Amounts for Public Work, from Replies to ENR Letters	Amounts for Road Work Included in Public Works Reported
Ala.	88	62	5,494	5,474
Ariz.	480	2,681	.....	.....
Ark.	19,089	240	.....	.....
Calif.	18,481	18,842	30,442	29,600
Col.	1,175	797	3,941	.....
Conn.	2,641	9,690	7,555	4,300
Del.	275	.....	4,700	4,700
D. C.	122	1,709	1,950	650
Fla.	900	4,538	.....	.....
Ga.	3,294	2,555	8,085	8,025
Ida.	1,046	105	5,000	5,000
Ill.	34,699	23,452	18,800	18,500
Ind.	35,880	1,105	16,000	16,000
Ia.	1,538	3,686	15,383	15,228
Kan.	3,625	4,641	14,185	13,880
Ky.	110	4,000	.....	.....
La.	520	1,661	5,000	5,000
Me.	120	138	2,969	2,469
Md.	10,942	2,502	6,374	6,374
Mass.	2,985	9,176	19,660	19,310
Mich.	5,995	20,698	16,025	15,125
Minn.	2,222	7,275	11,706	8,919
Miss.	.....	1,038	3,500	3,500
Mo.	76,094	12,702	10,100	10,100
Mont.	125	1,823	1,150	1,150
Neb.	643	1,174	7,705	7,115
Nev.	.....	.....	1,638	1,638
N. H.	.....	55	1,680	1,680
N. J.	9,830	12,470	6,760	5,078
N. M.	.....	.....	1,665	1,665
N. Y.	23,963	19,649	18,268	14,267
N. C.	3,410	300	100	100
N. D.	812	500	3,720	3,720
Ohio	28,767	19,447	20,720	10,502
Okla.	4,137	1,312	7,700	6,700
Ore.	4,486	4,618	11,001	6,998
Penn.	19,709	13,213	25,722	16,920
R. I.	327	516	1,735	1,098
S. C.	92	1,767	1,000	1,000
S. D.	171	600	3,650	3,650
Tenn.	625	1,909	1,449	1,449
Tex.	2,994	14,801	29,184	29,184
Utah.	1,468	3,707	4,176	2,544
Vt.	85	.....	850	850
Va.	1,157	1,491	4,250	4,250
Wash.	715	4,084	21,950	13,420
W. Va.	45	633	18,030	18,030
Wis.	7,646	7,914	14,740	14,625
Wyo.	123	4,730	1,260	1,260
Total	333,651	250,006	416,933	364,950

PROJECTED WORK BY CLASSIFICATIONS

	Dec.	Jan.	Total
Water Works	22,982	13,184	36,166
Sewers	4,128	12,048	16,176
Bridges	25,602	13,658	39,260
Streets and Roads	61,087	51,358	112,445
Excavation and Dredging	15,962	13,255	29,217
Industrial Bldgs.	58,860	22,795	81,655
Non-Industrial Buildings	102,749	97,310	200,059
Miscellaneous	42,281	26,398	68,679
Totals	333,651	250,006	583,657

Bursting of Molasses Tank in Boston Charged to Bad Design

A steel tank for storing molasses belonging to the United States Industrial Alcohol Co., and standing on the company's ground in Commercial St., Boston, burst Jan. 15, and 19 persons were killed. The tank was full, having been filled, for the first time in its history, two days before. It was 90 ft. in diameter by about 50 ft. high, and contained 48 ft. 10 in. of molasses when it burst. In an inquest on the deaths, Municipal Court Justice Bolster found Feb. 8 that the building law was violated in the obtaining of a permit and the passing of plans for the tank, and that the city building department passed the plans without technical examination. The plans were found to be defective. They were drawn to an order for a tank to hold molasses weighing 11¾ lb. per gallon, with a factor of safety of 3. Plans were prepared by the iron works that built the tank.

No evidence was found to show that explosion or external violence brought about the failure, though the molasses in the tank was in a process of fermentation at the time. The court finds:

"My conclusion from all this evidence is that this tank was wholly insufficient in point of structural strength to handle its load, insufficient to meet either legal or engineering requirements.

"I am satisfied that the adequate and predominating cause of this accident was a bursting from internal pressure exceeding its structural strength."

Columbus, Ohio, Engineers Effect Close Relation With Council

As in the case of Atlanta, Ga., an unpaid advisory engineering board is to be appointed to assist the city of Columbus, Ohio, and its officials in the consideration of questions of a technical nature. The action is the result of an effort of the Columbus Engineers' Club, which presented the matter to the mayor and council Jan. 23. It is not proposed that the board should render services of a nature conflicting with the legitimate duties of engineers employed by the city or to interfere with the employment of consulting experts as needed, but it should act simply as an advisory board for the purpose of aiding in a determination of policies in regard to improvements, and in the settlement of difficulties or differences of opinion which may arise from time to time, either during the preliminary stages or during construction.

A bill to establish a state board of engineering registration and to regulate the practice of civil and mining engineering and surveying is being pushed by the club. The mechanical, electrical and chemical engineers and other classes felt that the bill should include them. The club went on record as favoring the licensing of professional engineers and the appointment of representatives of the different branches of engineering to take part in the meeting of the Association of Ohio Technical Societies, when the bill will be considered finally.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS: 29 West 39th St., New York City; Feb. 17-20, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION: 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Providence, R. I., Engineering Society held its third annual banquet Feb. 12. Captain Delport, of the French Army, and Lieut. J. A. H. Muirhead, Royal Engineers, British Army, spoke on some of the engineering problems in connection with the armistice and reconstruction. Alfred D. Flinn, secretary of the Engineering Council, addressed the meeting on war activities of engineers. P. H. W. Ross, president of the National Marine League, spoke on "Public Participation in Maritime Affairs," and Leonard W. Cronkite of Boston, special agent of the United States Department of Labor, on "Cooperating for Reorganization." Newly released motion pictures were shown of the assembling and operation of 14-in. naval guns at the front, by Ensign C. S. McCrae, U. S. N. R. F., of the Naval Bureau of Ordnance.

The Colorado Society of Engineers was addressed by E. A. Moritz, of the United States Reclamation Service, on "The Engineer's Part in Reconstruction," at the third annual banquet of the society Jan. 25. A. L. Fellows, irrigation engineer, United States Department of Agriculture, read a paper on "The Future of Irrigation Engineering." Other papers read were: "Reconstruction and Good Roads," by T. J. Ehrhart, chairman of the Colorado State Highway Commission, and "Problems of Railroad Readjustment," by Arthur Ridgway, assistant chief engineer of the Denver & Rio Grande R.R. It was recently voted to change the name of the society from the "Colorado Society of Civil Engineers" to the "Colorado Society of Engineers."

The Detroit Engineering Society was addressed Feb. 7 by Dr. W. F. Rittman, of the United States Bureau of Mines, who spoke on "Motor Fuel," the principal theme of the address being the potential supply of fuel. The society will hold a joint meeting with the Michigan Chapter of the American Society of Heating and Ventilating Engineers, Feb. 21, at which L. D. Royer, of the Power and Construction Department, Ford Motor Co., will speak on "The Measurement of Flow of Liquids and Gases by Means of the Pitot Tube."

The American Association of Engineers will hold a conference in Chicago Mar. 17, under the auspices of its railroad committee, to discuss a tentative report of the committee, including the alleged need of an association of all railroad engineers to look after their economic welfare, and to consider the application of Order 27, and supplements, of the United States Railroad Administration, especially with reference to overtime and classification of engineers and rates of pay. W. H. Finley, chairman of the committee, will preside.

The Engineering Council will hold its annual meeting Feb. 20 at the Engineering Societies' Building, 29 West 39th St., New York City. The first session of the meeting will be held at 2 p. m. and will be continued in the evening, if necessary.

The International Federation of Draftsmen's Unions, Chicago, Local 14, accepted 122 new members at the semi-monthly meeting Feb. 1. John Fitzpatrick, president of the Chicago Federation of Labor, installed the following new officers for the year: President, M. J. Brown; vice-president, C. H. Monger; recording secretary, E. Hemmer; financial secretary, F. Wizeszez; treasurer, H. Matthei; business manager, F. C. Brodman, 4954 West End Ave., Chicago.

The Illinois Section of the American Water-Works Association will hold its 11th annual meeting at Urbana, Mar. 25-26.

The Engineers' Club of Seattle elected the following officers at the recent annual meeting: President, H. E. Horricks; vice-president, L. Murray Grant; secretary, E. J. Bartells, and treasurer, Amos Slater.

The Technology Club, Syracuse, N. Y., was addressed Feb. 3 by George T. Hammond of Brooklyn, who spoke on sewage disposal, in light of the plan of the City of Syracuse for a complete system of disposal. City officials attended as guests of the club.

The Louisiana Engineering Society was addressed by Maj. A. M. Shaw on "The Construction Division of the Army," at the regular meeting held Feb. 10.

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting Feb. 8, which was addressed by Walter L. Drager on "Federal Ownership of Railroads." The subject was discussed by Charles W. Comstock and Arthur O. Ridgway.

The Brooklyn Engineers' Club will be addressed Feb. 13 by William H. Grove, electrical engineer, Republic Engineers, Inc., New York City, who will speak on "A New 66,000-Volt Steel Tower Transmission Line in the Steel

Mill District of Ohio." A meeting of the club will be held Feb. 20, at which Walter E. Truesdell, of Joseph H. Wallace & Co., will speak on "Wood Pulp Machinery."

The Engineers' Club of Philadelphia will be addressed by Joseph A. Steinmetz on "News from the Peace Zone," at the weekly luncheon Feb. 18.

The Rochester Engineering Society, Rochester, N. Y., will hold its regular monthly meeting Feb. 14.

PERSONAL NOTES

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

J. H. KNOWLES, bridge engineer, Western Pacific R.R., Tidewater Southern R.R., and Deep Creek R.R., has been appointed chief engineer in charge of construction and maintenance of way and structures, under Federal Manager W. R. Scott, succeeding T. J. Wyche, resigned.

CAPT. D. A. TOMLINSON, until recently assistant senior instructor in orientation, Coast Artillery, Fort Monroe, Va., has become special agent, Professional and Special Section, United States Employment Service, with headquarters at 63 E. Adams St., Chicago, under Ward R. Robinson, manager, Central and Western Zone. Captain Tomlinson, who served six months on the Mexican border, was valuation engineer for the Chicago & Western Indiana R.R. He reënlisted at the outbreak of the war, acting first as camp adjutant to the constructing quartermaster, Camp Grant, Illinois, before entering the Coast Artillery service.

O. C. SMITH has been appointed manager of the recently reorganized Division of Steel and Machinery of the American International Shipbuilding Corporation at Hog Island, Penn. The division was previously known as the Division of Ship Design and Production. Other appointments in connection with the reorganization of the division are as follows: C. C. THOMAS will continue as manager of the department of machinery; C. L. HARKRADER has been appointed manager of the department of hull fabrication; H. W. OSGOOD will continue his duties as electrical engineer; D. E. BIGELOW as estimator. All of the departments and sections are in charge of Mr. Smith.

MAJ. JAMES C. F. SHAFER, 52nd Artillery, who previously was general manager of the Structural Concrete Co., Dayton, Ohio, has returned from France and received his discharge from the service. He has become vice-president of the Boldt Construction Co. of Cleveland, specializing in the construction of industrial and power plants.

W. A. LELAND, formerly president of the Tennessee Eastern Electric Co., Johnson City, Tenn., has been appointed chief engineer and general manager, Charleston Engineering and Contracting Co., Charleston, S. C.

MAJ. EDWARD D. RICH, Sanitary Corps, U. S. A., who was director of the School of Sanitary Engineering at Camp Greenleaf, Georgia, succeeding Maj. William C. Hoad, promoted to lieutenant colonel and ordered to the Surgeon General's office, has received his discharge from the service and has returned to his duties as state sanitary engineer of Michigan.

GEORGE W. BROWN, who for 21 years has been engaged in the construction and operation of coaling plants for the Navy Department, has been relieved from duty at the Naval fuel depot, Tiburon, Colo., and placed in local charge of coal storage for the department at Hampton Roads, with headquarters at Norfolk, Va.

I. W. MCCONNELL has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

CAPT. W. J. CARREL, Engineers, U. S. A., who was attached to the training school in highway engineering at Camp A. A. Humphreys for the instruction of replacement troops for the expeditionary forces, has received his discharge from the service and resumed his duties on the faculty of the College of Engineering, University of Kentucky, in charge of courses in structural engineering.

CHARLES L. SPAULDING, resident engineer, electric zone, New York Central R.R., with headquarters at New York City, has been appointed secretary and engineer to the Yonkers, N. Y., Water-Front Commission. In 1914 he became resident engineer in charge of construction work on four-tracking and grade-crossing elimination and new station buildings in the electric zone of the New York Central from the Grand Central Terminal to Harmon. He has also been engaged in the preparation of plans for the West Side improvement project of New York City.

H. G. BALCOM has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

CAPT. H. E. BABBITT, Engineers, U. S. A., who was engaged in work in the advance section in France, has returned to the United States and received his discharge from the service. He has resumed his work as associate in sanitary engineering, College of Engineering, University of Illinois.

JAMES G. ESCH, for the past year general manager of H. Schmitt & Son, Inc., general contractors, Milwaukee, has become vice-president of the Boldt Construction Co., Cleveland.

COL. C. H. CRAWFORD, U. S. A., formerly of the Purchase, Storage and Traffic Division, General Staff, has been elected director of the American Association of Engineers, succeeding T. M. Chapman, deceased. Colonel Crawford is now associated with the Baldwin Locomotive Works, Philadelphia.

J. A. L. WADDELL, consulting engineer of New York and Kansas City, has been made a corresponding member of the Sociedad de Ingenieros de Peru.

LESTER E. ARMSTRONG, previously of Babcock & Wilcox, has become advisory engineer for the Powdered Coal Engineering & Equipment Co., Chicago.

CAPT. HERBERT T. NOWELL, Engineers, U. S. A., who previously practiced as a consulting engineer in Montana and Wyoming, specializing in city planning and public works, has received his discharge from the service and is now at New Rochelle, N. Y.

G. L. GILLETTE has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

E. EARL GLASS, road department, Los Angeles County, California, has resigned to become sales manager, Hydrometric Co., Los Angeles, in charge of the sale of Reliance irrigation meters.

JOHN F. NEALIS, Aëro Observation, U. S. A., formerly engaged in research work for the United States Steel Corporation, has received his discharge from the service and become associated

with the Powdered Coal Engineering & Equipment Co., Chicago, as advisory engineer.

OBITUARY

WILLIAM N. BANNARD, formerly special agent, Pennsylvania R.R., in the office of the general manager, at Philadelphia, died in Wilmington, Del., Jan. 31. He was born in 1848 and was graduated from the Massachusetts Institute of Technology in 1869, when he entered the service of the West Jersey R.R. as a rodman. In 1872 he was appointed resident engineer of the West Jersey line, and two years later was made assistant engineer, New York Division, Pennsylvania R.R. In 1883 he was appointed superintendent of the Camden & Atlantic R.R., and a year later of the Schuylkill division. After serving for a short time as superintendent of the Schuylkill division he was appointed superintendent of the Amboy division, and afterward became superintendent of the Altoona division. In 1895 he was appointed superintendent of the Maryland division, with headquarters at Wilmington, and served in this capacity for 15 years, until his appointment as special agent in the office of the general manager.

DR. BROWN AYRES, president of the University of Tennessee since 1904, died in Knoxville Jan. 28, at the age of 62. He received his early education and course in civil engineering at Washington and Lee University and was afterward graduated from Stevens Institute. He was professor of physics, College of Technology, from 1880 to 1904.

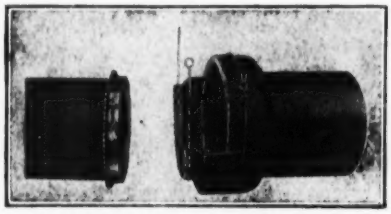
A. C. SCHILLING, attached to the Office of the United States Engineer, Mobile, Ala., died in that city Feb. 5. He was formerly connected with the engineering department of the Borough of the Bronx, New York City, and more recently had been assistant engineer and chief of sewers, United States War Department, in connection with installations at Camp Meade, Maryland.

FREDERICK DONALD HART died in Brooklyn, N. Y., Feb. 2, at the age of 84. He installed the first pumping engine for the Ridgewood pumping station of the old Brooklyn water-supply service. He also supervised the erection of the pumping engines, then said to be the largest of their kind, for Woodruff & Beach Iron Works, Hartford, Conn., installed in the Atlantic Ave., Brooklyn, pumping station in 1858. He remained in the service of the old City of Brooklyn as supervising engineer of the water-works until 1878, when he became associated with John W. Masury & Sons. He retired from active life in 1898.

Gasket and Form for Cementing Joints in Tile Pipe

A gasket and form has been designed by a New England contractor to simplify the making of waterproof cement joints in tile pipe sewers. It makes possible the maintenance of proper alignment of the invert while the pipe is being laid, and also the laying of the pipe in water.

The gasket consists of a sheet-iron flange, the inner edge of which is turned over to fit on the spigot end of the pipe, while the outer ring is notched to fit into the hub of the pipe into which it is to be placed. The outside diameter



GASKET AND FORM IN PLACE

of the gasket is the same as that of the inner diameter of the hub, and is held tight on the pipe by means of a small stove bolt through two lugs. The sheet-iron form is made to fit closely the outside of the hub as well as the pipe. It is placed on the lower half of the hub and is wired in place.

When pipe is laid the spigot with the gasket on it is placed in the hub in the usual manner and forced into place. No attempt is made to center the pipes, as the gasket does this automatically. The pipes are then tested for line and grade, and the trench is back-filled to a depth of one-half the diameter of the pipe. When this is done there can be no disturbance of the joints after they are made. After a convenient number of pipes have been laid in this manner the joints are poured with a thick grout from one side of the form. The upper half of the joint is then plastered with cement mortar in the usual manner.

With this device sewers have been laid in trenches containing water and with water running through the pipe to a depth of one-half the diameter of the pipe, thus saving the expense of pumping or the use of subdrains.

The device is made by L. A. Weston, Adams, Mass.

Foreign Trade Council Will Hold Convention in April

A formal call for the sixth National Foreign Trade Convention to be held in the Congress Hotel, Chicago, Apr. 24-26, 1919, was made by the president of the council. The urgency of the foreign-trade situation will be the theme of the convention.

"The abrupt termination of the war in Europe," says the chairman, "has brought the United States suddenly face to face with questions of grave concern to American foreign trade and industry."

BUSINESS NOTES

The Alexander Millburn Co., 1420 West Baltimore St., Baltimore, Md., announces that it has opened a branch office at 998 Monadnock Building, San Francisco, Cal., under the management of E. F. Walter.

Capt. Edward E. Ashley, Jr., formerly mechanical and electrical engineer for Starrett & Van Vleck, architects, New York City, has resigned his commission in the air service of the Army to accept an appointment as sales engineer of the Mercury Manufacturing Co., Chicago, Ill. The Mercury company manufactures electrically driven tractors for use in connection with industrial haulage systems.

Wharton Clay, director of the Military Training Camps' Association, has become associated with the Expanded Metal Manufacturers' Association as commissioner, and is located in the Cleveland office. Mr. Clay left the United States Gypsum Co. to take up association work when the association named above was founded.

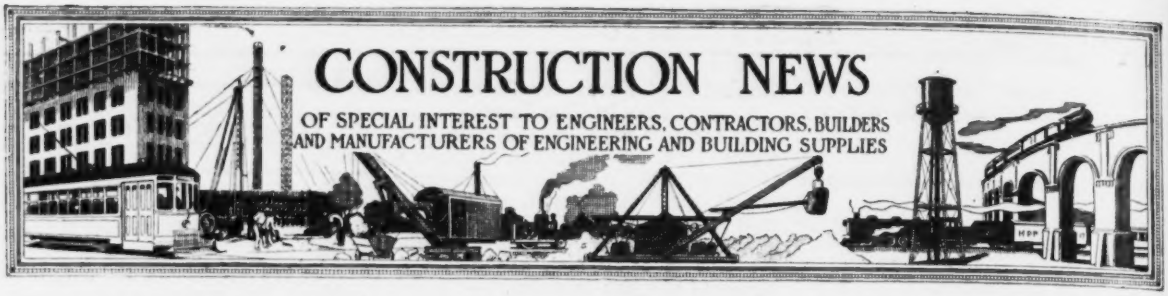
The Portland Cement Association announces the appointment of H. G. Meigs as district manager of its Milwaukee office, First National Bank Building, Milwaukee, Wis.

TRADE PUBLICATIONS

The A. S. Aloe Co., of St. Louis, Mo., has isued a supplementary catalogue describing and illustrating engineering, drawing and drafting supplies which the company carries in stock.

The Wallace & Tiernan Co., 349 Broadway, New York City, has issued a 65-p., 8¼ x 11-in., paper-bound book entitled "Chlorine Control Apparatus for Water and Sewage Purification." Besides being a treatise on the chlorination of water, its history and development, it contains a large amount of data and charts for use in the installation and operation of the apparatus manufactured by the company. It is illustrated with a large number of half tones showing the various equipment at work, as well as installations throughout the country. A summary of types and characteristics of the company's chlorinators is given.

The Blaw-Knox Co., Pittsburgh, Penn., has issued a pamphlet describing its automatic single-line clamshell bucket. The pamphlet illustrates the bucket in several operating positions, and gives other information regarding the machine.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 63a-b-c-64 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Feb. 18	Bayard, Neb.	Feb. 13
Feb. 18	Jersey City, N. J. Adv. Jan. 23, 30, Feb. 5 and 13.	Jan. 30
Feb. 19	Brunswick, Md. Adv. Feb. 6 and 13.	Feb. 13
Feb. 20	New York, N. Y.	Feb. 13
Feb. 20	Ottawa, Ont.	Feb. 13
Feb. 21	Akron, O. Adv. Feb. 6.	Feb. 6
Feb. 21	Bayonne, N. J.	Feb. 13
Feb. 25	East Chicago, Ind Adv. Jan. 30	Jan. 30
Feb. 28	Clarksburg, W. Va Adv. Jan. 30	Jan. 30
Mar. 7	Pembroke, Ont.	Feb. 6

SEWERS

Feb. 17	St. Paul, Minn.	Feb. 13
Feb. 18	Bayard, Minn.	Feb. 13
Feb. 18	Wyandotte, Mich.	Feb. 6
Feb. 19	Creedmore, N. Y.	Feb. 6
Feb. 20	Cleveland, O.	Feb. 13
Feb. 25	Columbus, O.	Feb. 13
Feb. 25	St. Louis, Mo.	Jan. 30

BRIDGES

Feb. 17	Los Angeles, Cal.	Feb. 6
Feb. 25	Sneedville, Tenn.	Feb. 13
Mar. 3	Bisbee, Ariz.	Feb. 6
Mar. 23	Buckhannon, W. Va.	Feb. 13

STREETS AND ROADS

Feb. 10	Fayetteville, W. Va. Adv. Jan. 23, 20 and Feb. 6.	Jan. 16
Feb. 10	Idaho	Jan. 30
Feb. 11	Indiana	Jan. 23
Feb. 11	Moulton, Ala.	Jan. 16
Feb. 11	Jasper, Tex.	Feb. 6
Feb. 12	Ft. Meyers, Fla.	Feb. 6
Feb. 14	Oswego, Kan.	Jan. 30
Feb. 14	Oswego, Kan.	Feb. 6
Feb. 17	Philippi, W. Va. Adv. Jan. 30 and Feb. 6	Jan. 23
Feb. 17	California	Jan. 30
Feb. 17	Tulsa, Okla. Adv. Jan. 23, 30 and Feb. 6.	Jan. 30
Feb. 17	St. Paul, Minn.	Feb. 6
Feb. 17	San Diego, Cal.	Feb. 6
Feb. 17	Virginia	Feb. 13
Feb. 17	St. Paul, Minn.	Feb. 13
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 18	Clifton, Ariz.	Feb. 6
Feb. 18	Indiana	Jan. 23
Feb. 18	Philadelphia, Pa.	Feb. 13
Feb. 18	Santa Ana, Cal.	Feb. 6
Feb. 20	Hamlin, W. Va.	Jan. 23
Feb. 20	Rumson, N. J. Adv. Jan. 23, 30, Feb. 6 and 13.	Jan. 23
Feb. 20	Santa Barbara, Cal.	Feb. 13
Feb. 24	Los Angeles, Cal.	Feb. 13
Feb. 24	Middlebourne, W. Va. Adv. Jan. 23, 30, Feb. 6 and 13.	Jan. 30
Feb. 25	Columbus, O.	Feb. 13
Mar. 1	Shreveport, La.	Feb. 13
Mar. 3	Indianapolis, Ind.	Feb. 6
Mar. 3	Marshall, Minn.	Feb. 13
Mar. 4	Ripley, W. Va.	Jan. 23
Mar. 4	Indianapolis, Ind.	Feb. 6
Mar. 5	Alexandria, Minn.	Feb. 6
Mar. 6	Fairmont, W. Va. Adv. Jan. 30, Feb. 6 and 13.	Feb. 6
Mar. 31	Lockport, N. Y.	Feb. 6

EXCAVATION AND DREDGING

Feb. 17	Tunica, Miss.	Feb. 6
Feb. 18	Jonesboro, Ark.	Feb. 6
Feb. 18	Albany, N. Y. Adv. Jan. 23, 30 and Feb. 6.	Jan. 23
Feb. 19	Albany, N. Y. Adv. Jan. 23, 30, Feb. 6 and 13.	Jan. 23
Mar. 13	Tyler, Minn.	Feb. 6
Apr. 8	Hollandale, Miss.	Feb. 13

INDUSTRIAL WORKS

Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 21	Brooklyn, N. Y.	Feb. 6
Feb. 25	New York, N. Y.	Jan. 30
Mar. 4	Thiells, N. Y.	Jan. 16
Apr. 1	Sioux City, Ia.	Jan. 16

BUILDINGS

Feb. 14	Brooklyn, N. Y.	Jan. 23
Feb. 14	Malone, N. Y.	Feb. 6
Feb. 15	Far Rockaway, N. Y.	Feb. 13
Feb. 17	New York, N. Y. Adv. Feb. 6.	Feb. 6
Feb. 19	Brooklyn, N. Y.	Jan. 30
Feb. 19	Chicago, Ill.	Feb. 13
Feb. 19	Waterloo, Ia.	Feb. 6
Feb. 20	London, Ont.	Feb. 13
Feb. 20	Magnolia, Minn.	Feb. 13
Feb. 21	Cincinnati, O.	Feb. 13
Feb. 21	Phillipsburg, O.	Jan. 30
Feb. 24	Norwood, O.	Jan. 23
Feb. 24	Cincinnati, O.	Jan. 30
Feb. 24	Cleveland, O.	Feb. 13
Feb. 25	St. Louis, Mo.	Feb. 13
Mar. 1	Cloquet, Minn.	Jan. 30
Mar. 1	Cloquet, Minn.	Feb. 13
Mar. 1	Mountain Iron, Minn.	Jan. 30
Mar. 1	Duluth, Minn.	Jan. 23
Mar. 1	Duluth, Minn.	Feb. 6
Mar. 3	Rockport, Ill.	Jan. 23
Mar. 4	Utica, N. Y.	Feb. 13
Mar. 4	Wards Island, N. Y.	Feb. 13
Mar. 15	Culver, Ind.	Dec. 26
Mar. 15	Duluth, Minn.	Feb. 13
Apr. 2	New York, N. Y.	Jan. 23
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6

FEDERAL GOVERNMENT WORK

Feb. 15	Laboratory — Washington, D. C. Adv. Jan. 23.	Jan. 23
Feb. 15	Laboratory — Washington, D. C.	Feb. 6
Feb. 17	Piping and Circulating System — Spec. 3416 — Portsmouth, N. H.	Jan. 30
Feb. 17	Crane Runway—Spec. 3769 —Philadelphia, Pa.	Feb. 6
Feb. 17	Electric Elevator—Spec. 3731 —New York, N. Y.	Feb. 6
Feb. 17	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Jan. 30
Feb. 17	Equipment, etc.—Spec. 3328 Hampton Roads, Va.	Jan. 30
Feb. 20	Surgical Dressing Room— St. Louis, Mo.	Jan. 30
Feb. 21	Dredging, etc. — Norfolk, Va. Adv. Jan. 23, Feb. 6 and 13.	Jan. 23
Feb. 21	Dredging—Norfolk, Va. Adv. Feb. 6.	Feb. 6
Feb. 24	Addition to Dispensary—Spec. 3780—Rockaway, N. Y.	Feb. 6
Feb. 24	Piping and Equipment—Spec. 3759—New York, N. Y.	Feb. 6
Feb. 24	Dredging—Spec. 3774—Chatham, Mass.	Feb. 6
Feb. 24	Wells and Pumps—Spec. 3577 —North Ft. Worth, Tex.	Feb. 6
Feb. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Vallejo P. O.) Cal.	Jan. 30
Feb. 25	Jetty Work—Sabine Pass, Tex. Adv. Jan. 30, Feb. 6 and 13.	Jan. 23
Feb. 27	Post Office—Martinsburg, W. Va.	Feb. 13
Mar. 1	Foundation and Rip Rap—Baltimore, Md. Adv. Jan. 16.	Jan. 16
Mar. 1	Dredging—Superior, Wis.	Jan. 16
Mar. 3	Barracks — Spec. 3728 — Fire Island, N. Y.	Jan. 30
Mar. 3	Barracks—Spec. 3733—San Diego, Cal.	Feb. 13
Mar. 3	Hospital—Baltimore, Md.	Feb. 13
Mar. 3	Post Office—Walden, N. Y.	Feb. 6
Mar. 7	Lavatory Annexes — Shiprock, N. M.	Feb. 13
Mar. 7	School and Assembly—Hall —Wahpeton, N. D.	Feb. 13
Mar. 10	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Feb. 13
Mar. 11	Dredging — Philadelphia, Pa. Adv. Feb. 6 and 13	Feb. 13

MISCELLANEOUS

Feb. 13	Road Oil, Asphalt, etc., Montclair, N. J.	Jan. 30
Feb. 14	Additional Window Guards —Bedford Hills, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 14	Pier—Philadelphia, Pa. Adv. Jan. 23.	Jan. 23
Feb. 18	Truck, Tractor, etc.—New York, N. Y.	Feb. 13
Feb. 19	Gantry Crane — Seattle, Wash. Adv. Jan. 2 and 9.	Jan. 2
Feb. 19	Dam—Los Angeles, Cal.	Feb. 6
Feb. 19	Gasoline — New York, N. Y.	Feb. 13
Feb. 20	Oiling—Baltimore, Md. Adv. Feb. 6 and 13.	Feb. 13
Feb. 21	Crushed Rock—Visalia, Cal.	Feb. 6

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mass., Boston—Metropolitan Water & Sewerage Bd. filed bill in State Treasury for authority to issue $11,000 bonds to complete watermains in East Boston.

Md., Cumberland—City plans to lay 3 mi. water pipe and build sewers in various streets. About $165,000 available for projects. R. L. Rizer, city engr.

Ga., Atlanta—City plans election Mar. 5 to vote on $500,000 bonds for improvements to water works system, including pumps, etc. H. L. Collier, city engr.

Ky., Ashland—City plans to purchase and improve water works system and build filtration plant and pumping station. T. Boggess, city engr.